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MODEL Airplane NEWS

APRIL 2004, VOLUME 132, NUMBER 4

FEATURES

FLIGHT TESTS

CONSTRUCTION

COLUMNS

***ON THE COVER:** powered by a Fuji 50cc gas engine, the Great Planes Christen Eagle II is a great flying IMAA-legal aerobatic biplane (photo by John Reid). **ON THIS PAGE:** Aviomodelli's Piper Arrow 2 is reviewed by Jim Onorato on page 60 (photo by Deron Neblett).*

DEPARTMENTS

EDITORIAL

BY DEBRA CLEGHORN

Advanced aerobatics

Whether we are sport fliers or have expert thumbs, we all experience a thrill when we successfully perform aerobatic moves. For some of us, that might be flying a perfect loop; for others, it's a difficult 3D maneuver. In this issue, we have something for everyone. On page 42, World Aerobatics champion Quique Somenzini continues his flight techniques series by discussing the importance of flight-mode groups and control-throw setups, using the basic snap roll as a sample maneuver. Do you want an even bigger challenge? Try the Pendulum, one of Quique's signature 3D moves. In this descending maneuver, the airplane goes through extreme yaw changes and actually looks like the pendulum of a clock. It doesn't get much more exciting than this! (Note: it's always a good idea to practice a few mistakes high!)

IN THE WORKSHOP

Looking for some useful building and setup tips? Scale enthusiasts won't want to miss this month's "Scale Techniques" column, in which Dick van Mourik explains how to make replica parts out of sheet aluminum. Not only do aluminum parts look really good, but they're actually very light, sturdy and malleable as well. See Dick's article on page 112 for the inside scoop.

In "Powerlines," columnist Greg Gimlick shares some basic wiring tips for electric-powered planes, including what you need to know about series versus parallel circuits. As Greg notes, he isn't designing vehicles for NASA, so you won't need to get out your calculators and computer spreadsheets to understand his methods.

How can you avoid the "big crash"? One easy way is to make sure your model's center of gravity (CG) is correct. In Jerry Smith's "Know your CG" article on page 88, he explains how to determine this critical location and how to get your plane to balance correctly. With this one simple step, hundreds—maybe thousands—of planes will live to fly another day!

Our featured construction article this month is Dick Sarpolus's 35-inch-span sport aerobat, the "Electric Angle." This Speed 400 model uses traditional, built-up balsa and ply construction, flies fairly fast and has good aerobatic capabilities. Famous for his giant-scale designs, Dick has been bitten by the backyard RC bug and says that he really likes being able to keep a few small models in his car so he can fly anywhere, anytime.

15 YEARS OF JETTING AROUND

The Arizona Model Aviators have truly witnessed the evolution of jet models in the 15 years they've hosted the Arizona Jet Rally in Mesa, AZ. Glow-powered ducted fans have been leapfrogged by turbines, and they, in turn, by the high-performance capability of electric ducted fans. This year, associate editor Rick Bell was there, camera in hand, to capture history in the making on film; turn to page 30 to see highlights of this year's event.

Safe landings!

WRITE TO US! We welcome your comments and suggestions. Letters should be addressed to "Airwaves," *Model Airplane News*, 100 East Ridge, Ridgefield, CT 06877-4606 USA; email man@airage.com. Letters may be edited for clarity and brevity. We regret that, owing to the tremendous numbers of letters we receive, we cannot respond to every one.

RISING SUN WARRIOR

Talk about perfect timing! I had been contemplating giving myself the giant-scale Japanese Zero from The World Models as a gift, and then your March 2004 issue shows up in my mailbox. I have always loved the clean lines of the Zero, and I think there are way too many Allied fighters in the world. It is a perfect air weapon for chasing around all those Mustangs. The review reports that the author used a Moki 2.10 glow engine to power his model, but I would like to use a gas engine. Do you have any suggestions? Again, thanks for the timely information and that great cover photo! I'm psyched to get my own rising-sun warrior!

Phillip Stephens [email]

Phillip, The World Models Zero is a beautiful IMAA-legal warbird, and we agree that West Coast editor John Reid's cover photo makes us want to get one as well! With its 80-inch span and 1,085 square inches of wing area, the Zero is perfectly suited to several gasoline engines. For general all-around fun flying, a ZDZ 40cc engine or a Zenoah G-38 would power it nicely. If you want to up the power to the max, you could squeeze a Fuji 50 or a Quadra 52 into the nose,

but you may have difficulty enclosing the muffler completely. The larger engines would also increase overall weight, and the wing loading (and landing speed) would go up as well; but it is possible. My choice would be a lightweight 40cc-class engine such as the ZDZ. Banzai! *GY*

PHOTO PERFECT!

In his article "12th Annual Warbirds over Delaware" (November 2003 issue), Gerry Yarrish featured some really great flight shots of the model warbirds. I try to take pictures of models at our local flying field, but they never come out right. What's the secret? I especially loved the sequence of the hard-luck Mustang coming in for a "landing" on pages 34 and 35. Keep up the good work.

John Hartmann [email]

John, we're glad you like our work! There really isn't a secret for getting the in-focus, close-up flight photography that is the Model Airplane News *trademark. The two main "ingredients" needed are good equipment and practice. The field equipment most editors take to flying events is a Nikon F5 camera and several Nikon lenses. We use a fixed 300mm lens for most flight shots but sometimes switch to a zoom 80 to 200mm for static and general crowd photos. A 35 to 70mm zoom is great for static work. Recently, we also started using a 3.2-megapixel Nikon CoolPix 990 digital camera for close-up detailed photography. This has saved us a lot of film! And speaking of film, we use Fuji 64 color-slide film for all our flight shots.*

To take the photos, we set ourselves up with the sun at our backs, and we stand as close as we can to the pilots without getting into trouble with the safety officers. We try to listen to the pilots as they talk to one another so we'll know what they will be doing. On average, we shoot between 20 and 40 rolls of 36-exposure film during a three-day event. You have to shoot a lot of "bullets" to hit the mark. Of all the pictures shot, about 50 percent are rated decent, and of these, our art department usually finds that one in 10 is worthy of the color spreads you see in Model Airplane News. *In the case of Scott Bonomo's "hard landing" P-51, it was one of those rare moments when we were at the right place at the right time with our camera pointed in the right direction. GY*

SILVER DART SAGA

I read with great interest the "Build your own full-size model!" column in the January 2004 issue. Having just completed a full-scale replica of the "Silver Dart"—the Canadian equivalent of the Wright Flyer—to coincide with the Centennial of Flight, I know what lies ahead for anyone who attempts to build a full-scale model of a vintage airplane.

Built in 1909, the Silver Dart was the brainchild of Alexander Graham Bell, who was a summer resident of Nova Scotia. Bell had formed a Canadian association to design and build a powered aeroplane. The association's members included Glenn Curtiss and J.A.D. "Doug" McCurdy—the Silver Dart's first pilot.

It took a great deal of research to come up with original drawings, many of which did not include dimensions! We used computer drawings to fill in the gaps, and the entire project was completed in about nine months. The Dart is now displayed at the Aero Space Association Museum in Calgary.

We used original construction materials wherever practical, but the wing, canard, rudder and aileron surfaces were built using modern materials. We maintained the integrity of design and built 90 percent of the hardware from scratch.

Air museums such as ours need to expand their collections, particularly if they have restoration facilities. The Aero Space Association Museum of Calgary has the parts to restore an original Hawker Hurricane and a de Havilland Mosquito, and it's exciting to know that a company such as PPE can produce blueprints and laser-cut parts for any airplane, thus expanding a museum's horizons. Could you put me in touch with them?

Thank you! Your magazine is a constant joy to this model builder and former F-86 fighter pilot.

Richard Kiser
Calgary, Alberta, Canada

Richard, congratulations on completing your full-scale Silver Dart (the original is shown above left). You'll undoubtedly have many war stories to swap with the folks at PPE! You can reach them at (480) 348-3733; arizonamodels.com. MO

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AIR SCOOP

by the Model Airplane News *crew*

NEW PRODUCTS hit the model airplane market all the time, so here's the inside source for what's hot and where you can get it. For every issue, we sift through product announcements, show reports, rumors and prototypes to let you in on the best and the latest. Remember, you saw it here first!

BALSA USA
Fokker D-VII

New from Balsa USA is an all-wood, built-up kit for a ¼-scale Fokker D-VII WW I German fighter. The Fokker D-VII includes rolled, full-size plans, step-by-step photo-illustrated instructions, formed landing gear and cabane struts and a built-up, wooden engine cowl. Hardware includes control horns, landing-gear straps, screws, hinges, etc. Specs: wingspan—88 in.; length—68⅞ in.; wing area—2,225 sq. in.; weight—18 to 20 lb. A 1.20 to 1.50 4-stroke or 25 to 35cc gasoline engine is recommended.
Balsa USA (906) 863-6421; balsausa.com.

KAVAN
BLUE DEVIL ARF

Looking for 3D action? The Blue Devil offers an easy way to try this popular form of aerobatic flight. Large control surfaces and advantageous power-to-weight ratios bring the thrills of extreme aerobatics to electric power. With an all-balsa-and-plywood construction, the Blue Devil is expertly covered in Oracover film and comes with a fiberglass engine cowl and wheel pants. It also comes with a Kavan 300 Plug & Fly motor with K2 Gold connectors, a Kavan SPF gearbox, an APC propeller, wheels, hardware, decals and an illustrated assembly manual. Specs: wingspan—32.7 in.; wing area—294.5 sq. in.; length—31.5 in.; weight—16 to 18 oz.; radio required—4-channel with four microservos; $254.99.
Kavan; distributed by Sig Mfg. Co. (641) 623-5154; sigmfg.com.

O.S. ENGINES
.91 SX-H RINGED HELI ENGINE

Specially designed for competition, the latest heli eng from O.S. is equipped with a Perry pump to ensure a c sistent fuel delivery, regardless of the heli's attitude. new, 60M large-bore (10.6mm) carburetor ensures gre engine power, and the engine's round, blue-anodized h sink head features a redesigned combustion chambe complement the pump system and horizontal fins to cooling. It has the same high-performance advantage the non-pumped version, including a lighter piston conrod and a balanced crankshaft that significar reduces high-rpm vibration. Specs: displacement—0.91 bore—1.09 in.; stroke—0.98 in.; practical rpm rang 2,000 to 16,000; weight—20.5 oz.; $549.99.
O.S. Engines; distributed by Great Planes; osengines.c

WATTAGE
Staggerwing Beechcraft

WattAge's new Staggerwing 400-EP ARF is a spectacular model of a timeless Depression-era beauty. This full-house, small-field performer features a detailed scale fuselage molded of durable ABS and an all-wood wing and tail, and it comes with a Super 400 cobalt motor, a 7x4 propeller and a complete micro hardware package. The Staggerwing's quick-connect wing-strut mounts make its one-piece wings easy to install and remove. Specs: wingspan—28 in.; wing area—260 sq. in.; weight—23 to 27 oz.; wing loading—13 to 15 oz./sq. ft. Price? Just $169.95.
WattAge; distributed by Global Hobby Distributors (800) 854-8471; (714) 963-0133; globalhobby.com.

HOBBY LOBBY
MINI TELEMASTER

This new kit packs all of the popular Senior Telemaster's excellent flight characteristics into a 45-inch-span park flyer! The easy-to-build kit costs just $29.90 and comes with laser-cut wooden parts, wire landing gear and a tailskid. When powered by the UBR1208 Nippy external-rotor motor, the model has lots of power for short takeoffs and steep climbs, and it's light enough to float in for slow and easy landings. Specs: wing area—325 sq. in.; weight—20 oz.; wing loading—9 oz./sq. ft. The Mini Telemaster has 3-channel control.
Hobby Lobby Intl. (615) 377-6948; hobby-lobby.com.

GIANTSCALEPLANES.COM
ZERO

The terror of the Pacific theater in WW II, the Japanese Zero was legendary for its exploits. Now you can be flying a beautifully built scale model in no time! This 71-inch-span Mitsubishi A6M5 has fantastic details and a fiberglass fuselage and cowl. The sheeted-foam wings are covered with Solartex cloth, and the entire airframe has been airbrushed. The wing is complete with CA hinges, and the plane comes with full-color decals. A 1.08 2-stroke or 1.20 4-stroke is recommended. Specs: length—60 in.; weight—10.75 to 11.25 lb.; wing area—884 sq. in. The GiantScalePlanes.com Zero costs $349.99.
Giantscaleplanes.com (610) 282-4811.

LRP
Electronic Speed Controls

Distributed in the U.S. by Team Associated, LRP's line of electronic speed controls (ESCs) are well known in RC car circles for their excellent quality and performance. The company also manufactures a number of airplane ESCs, but fliers here may not be familiar with the brand because they were not distributed in the U.S. Now there's a U.S. distribution network via Team Associated, and that's great news for electric fliers. The LRP Stratos BEC airplane line comes in three configurations—23A, 38A and 53A (weighing 21, 24 and 27 grams,

respectively)—and can handle 6 to 12 cells at constant currents. Each offers four motor and braking programs, programmable low-voltage warning and motor-start protection, and the 4000Hz PWM frequency maximizes efficiency. The units also feature easy push-button programming, two-color LEDs and factory-programmed default settings for plug-and-play operation. Prices weren't available at presstime, but by the time you read this, you'll be able to learn more by contacting Team Associated.
LRP; distributed by Team Associated (714) 850-9342; teamassociated.com; lrpelectronic.de.

VMAR
Hornet

With its semisymmetrical wing, this sport trainer is the ideal second model for pilots who want to try aerobatics. Its all-wood construction is durable enough to handle less-than-perfect landings, and its super-tough Polycote ECS polyester covering has highly visible graphics embedded in it (no decals that might lift off!). It comes out of the box with all the control surfaces installed and pinned and with all the required hardware, including a servo tray, installed control rods, a spinner and landing gear. The installed engine mount will fit most popular .46s, including the VMAX .46 and .52 Pro engines. Available in blue and red trim schemes, the Hornet costs just $89.95. Specs: wingspan—63.25 in.; wing area—730 sq. in.; length—48 in.; weight—6.25 to 6.5 lb.; 4 channels.
VMAR; distributed by Richmond RC Supply Ltd. (604) 940-1066; richmondrc.com.

VANGUARD VANCOUVER

Fairey Firefly

Designed by Vance Mosher, this IMAA-legal, 1/6.2-scale, rolled CAD plan set includes 60 square feet of original plots (not copies). The model is built using traditional balsa and plywood construction, and many molded parts and decals are available. A 43-page manual, a CD-ROM with 125 construction photos and scale documentation are also included. Building details such as the sliding canopy, the battery and servo locations, control runs and flap actuation are shown on the plans. Laser-cut wooden parts will soon be available. Specs: wingspan—80.5 in.; wing area—1,283 sq. in.; weight—20 lb.; power—1.08 2-stroke, 1.20 4-stroke glow, or G-38 gas. The plans set costs $65.

Vanguard Vancouver; vanvan.us.

ZURICH INTL.

REMOVABLE OPTICS

Want to enjoy the benefits that Zurich's renowned sunglasses offer, but you need prescription lenses? Now that Zurich has added Removable Optics to its product line, you can have both! Removable Optics are thin, clear-plastic wafers that adhere to the inside of most non-prescription sunglasses with water and a drop of liquid dishwashing soap. Removable Optics are available in a wide range of power: -1.00 to -14.00 and +50 to +8.00. The 1mm-thin wafers are extremely light and durable, and they're nearly invisible from the front and sides. Check them out and enjoy prescription sunglasses at a fraction of the cost.

Zurich Intl. (800) 533-5665; (916) 691-6467; zurichsunglasses.com.

EVOLUTION ENGINES

Ready to Start Powerplants

When you get to the field, you want a few hours of worry-free fun. You don't want to mess around with a stubborn engine that doesn't start. Evolution presents a new engine breed: one specifically designed to accommodate sport pilots who would rather be flying than tuning. Each Evolution engine is engineered for ease and efficiency to guarantee a no-fuss flying experience. There's no need for setup or break-in; just install it and go fly. And all Evolution 2-strokes, including this new .36NT, offer preset SetRight needle valves that take all the guesswork out of operation, a canted glow plug that tilts the glow driver away from the propeller for safer operation and a ball-bearing-supported crankshaft that provides more power and longer engine life. And for ultimate power, the bore, stroke and timing have been carefully engineered for use with mufflers and tuned pipes.

Evolution Engines; distributed by Horizon Hobby Distributors (800) 338-4639.

CHASE-DURER

PILOT COMMANDER XVA

It's always time to fly when you're wearing this accurate pilot's watch! This beautiful timepiece has a power alarm and chronograph and indicates elapsed times and lap times; its bevel slide rule allows pilots to calculate distance to "target" and fuel consumption. The Commander's solid, stainless-steel case is water-resistant to 330 feet and has a 3-year warranty; it costs $349. Check out the full line of Chase-Durer pilot's watches online at chase-durer.com.

TIPS & TRICKS

Illustrations by Richard Thompson

SEND IN YOUR IDEAS. *Model Airplane News* will give a free, one-year subscription (or a one-year renewal, if you already subscribe) for each idea used in "Tips & Tricks." Send a rough sketch to *Model Airplane News*, 100 East Ridge, Ridgefield, CT 06877-4606 USA. BE SURE THAT YOUR NAME AND ADDRESS ARE CLEARLY PRINTED ON EACH SKETCH, PHOTO AND NOTE YOU SUBMIT. Because of the number of ideas we receive, we can neither acknowledge each one nor return unused material.

TIE UP LOOSE ENDS

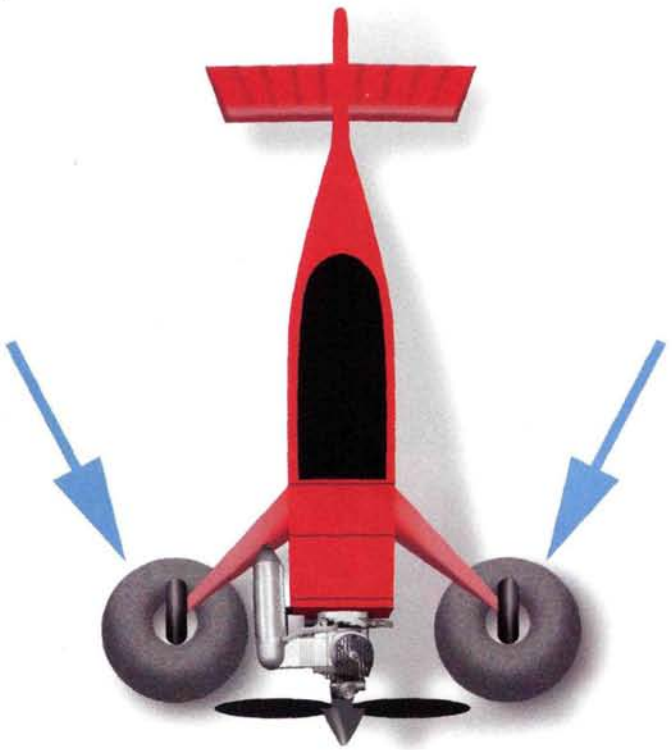
Your control over an airplane is only as secure as the plane's servo-extension connections. Try this tip to make sure that yours don't come loose during an aggressive aerobatic maneuver or a bumpy landing. Simply take the leads and cross them over in a half-knot, and then plug them together. Any tension on the leads will draw the knot tighter and make it next to impossible for the connections to come undone; but if you ever need to disconnect them, you won't have to mess with tape or glue joints. This tip works so well—no wonder they named a town after Poly!

Poly Aguada, Aguada, Puerto Rico

BIND-FREE CA HINGES

When installing pin hinges in a model, it's easy to get glue in the hinge if you aren't careful. Dwain Hiers sent in this technique from his friend Tom Kelly that ensures that all your hinges won't become frozen or fouled by CA or other adhesives. Use a covering iron or another medium-temperature heat source to melt about a teaspoon of petroleum jelly in a mixing cup. Slide a T-pin through two holes in the hinge, and hold the pin with forceps, pliers, or another suitable tool. Dip the barrel end of the hinge in the liquid for a few seconds (just long enough for the fluid to work itself all the way into the joint). Remove the hinge, flex it a few times, then let it drain and dry on a paper towel. Now, even if you dribble a little excess glue into the hinge, it won't bond to the moving parts!

Dwain Hiers, Fairmount, IN



WHEEL-CHOCK DONUTS

If you don't always have a helper at your flying field to assist with engine starting and run-up, here's an inexpensive and readily available item that is perfect for holding your plane while you fire it up. Home-improvement stores sell concrete donuts to surround and protect sprinkler heads in lawns that have built-in sprinkler systems. They're available in several sizes and work great as wheel chocks. They're heavy enough to hold a plane of any size, are easily portable and don't need to be staked down or assembled.

Steven Garris, DeBary, FL

GET A HANDLE ON YOUR GEL-CELL

When you first install a gel-cell in your flight box, you may not be thinking about the day when it will go bad and you'll have to replace it. Take a minute to encircle the battery case with a length of packing tape (the kind with nylon bands is strongest), and fold over a length of it to use as a lifting handle. If you do, when that day comes, you'll have a much easier time reaching in and lifting the battery out.

Jim Miller, Salt Lake City, UT

PILOT PROJECTS

SEND IN YOUR SNAPSHOTS. *Model Airplane News* is your magazine and, as always, we encourage reader participation. In "Pilot Projects," we feature pictures from you—our readers. Both color slides and color prints are acceptable, but please do not send digital printouts or Polaroid prints. Emailed submissions must be at least 300dpi. We receive so many photographs that we are unable to return them. All photos used in this section will be eligible for a grand prize of $500, to be awarded at the end of the year. The winner will be chosen from all entries published, so get a photo or two, plus a brief description, and send them in! Send those pictures to "Pilot Projects," *Model Airplane News*, 100 East Ridge, Ridgefield, CT 06877-4606 USA.

¼-SCALE RYAN PT-22

Chuck Vettes, Rancho Cucamonga, CA

Built from an Ikon N'West kit, Chuck's PT-22 has a 90-inch wingspan and an all-up weight of 22 pounds. He powers it with a 5-cylinder O.S. radial 4-stroke engine; nine Hitec servos, a Futaba PCM receiver and a Futaba 9Z transmitter provide control. The model's fuselage is covered in chrome Ultracote and black Solartex; all other surfaces are covered with 21st Century fabric. The Ryan features fully functioning landing gear, flaps and flying wires. According to Chuck, the big radial sounds amazing, and the plane flies with authority. He adds that it "... comes in a bit hot without the flaps but settles in nice for some pretty landings."

½A WITTMAN TAILWIND W-10

Andrew Porreco, Port Orange, FL

Andrew designed this beautiful 42-inch-wingspan model from 3-views and photos of Steve Wittman's homebuilt after he saw Steve's plane on the Discovery Wings Channel. It's powered by a small Norvel engine that performs flawlessly and gives the plane plenty of thrust. Says Andrew, "The model has met all my design and performance expectations and flies just like the real classic homebuilt: fast and aerodynamically clean."

VICTOR

Walter Gremlitz, Sun City Center, FL

Walt writes, "I'm an old U controller, now learning RC flying at Tampa RC Aircraft Club." His Victor is by Italian kit manufacturer Aviomodelli. Its molded fuselage, rudder, firewall, wing joiner, wingtips and fixed fin are all made of Duraflex—a light, strong, resilient plastic. He used Pactra paint and Great Planes pinstriping on the 63-inch-wingspan plane, and it's powered by an O.S. .40 4-stroke. Walt adds, "Though the plane is a trainer, I feel it's too nice to practice with." We can't argue with that!

SCRATCH-BUILT J2F-6 DUCK

Vern Coop, Joliet, IL

Vern built this terrific ¼-scale Grumman/Columbia J2F-6 Duck from 3-views that were published in the March 2000 issue of *Model Airplane News* and 3-views and photos from Bob Banka. It took Vern six months to build the plane; it's made of balsa, spruce and ply, and it's covered with 21st Century fabric and fiberglass cloth. The Duck has a 120-inch wingspan and weighs 54 pounds; it's powered by a 3W 1.50 engine and uses JR radio equipment. Vern tells us that he has flown it three times so far, and the modified Robart retracts work excellently. He adds, "Takeoffs and landings on water are absolutely real—a little bounce and a lot of spray!"

P-47D "HAIRLESS JOE"

Dave Gianakos, Littleton, CO

This 1/6-scale model P-47D by Aerotech replicates a WW II fighter that was named for a character from the "Li'l Abner" comic strip. Dave built it out of carbon fiber, and the wings and fuselage have all of their rivets, screws, panel lines and fasteners molded into the skin. Powered by a Brison-Sachs 4.2 2-stroke engine, the "Hairless Joe" weighs about 32 pounds. Dave painstakingly added details such as a scale droppable fuel tank and 500-pound bombs; retractable landing gear and Fowler flaps; retractable handholds and footholds; and an accurately detailed interior. Great job!

EINDECKER 46
Lonnie Brinson
Statesboro, GA

Lonnie re-covered his Eindecker with metallic charcoal MonoKote to give it a unique semi-scale look. His model is powered by a Magnum XL .61 RFS 4-stroke engine and has an M60 "lock and load" machine gun installed. "The Eindecker is on the hunt for the Red Baron," Lonnie informs us. Go get him!

FOKKER DR.1
Eddie Kizer, Granite Falls, NC

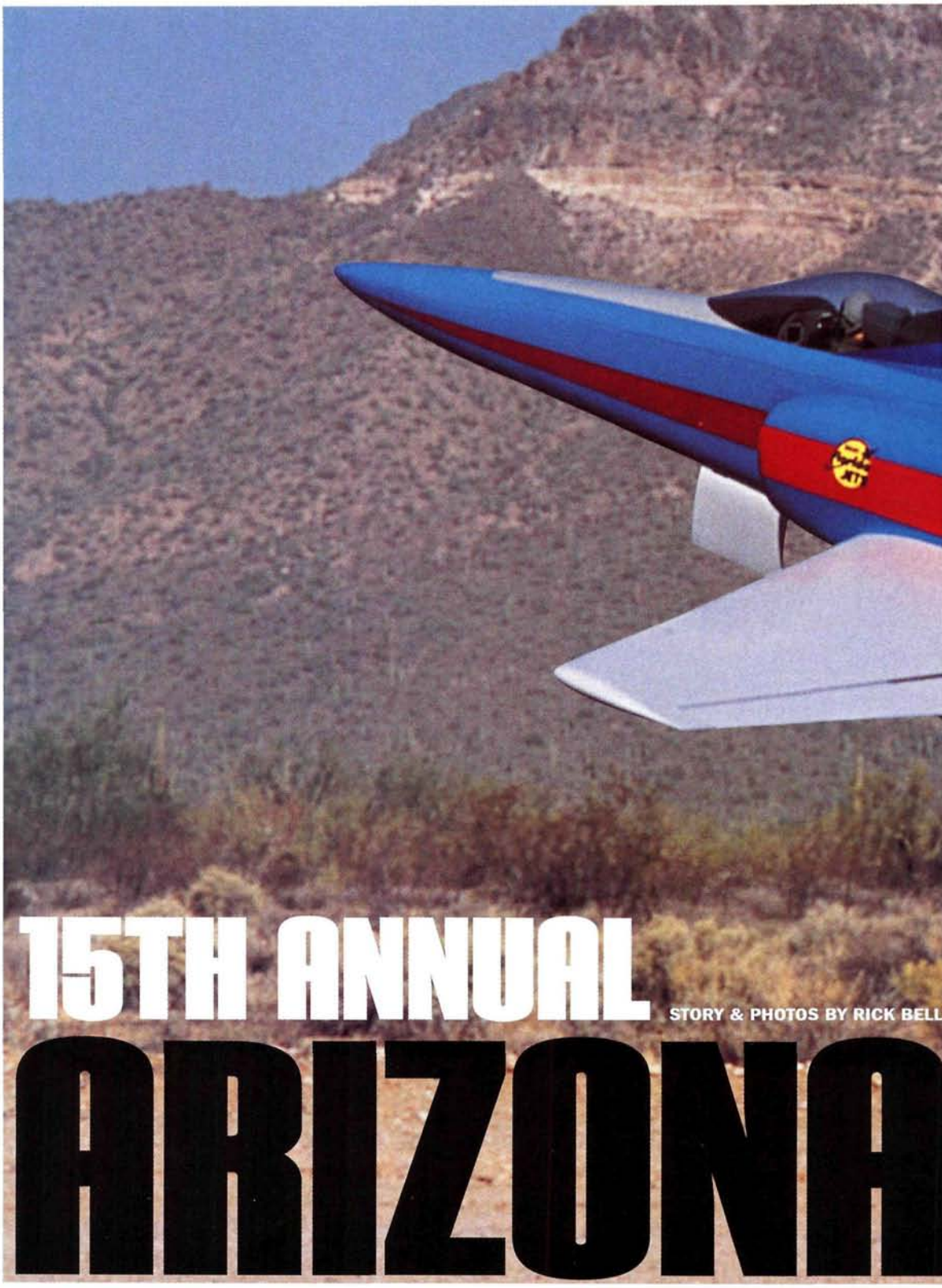
Discovering that one is good, but two are better, Eddie built a second Great Planes Fokker Dr.1 for twice the fun! He added Great Planes floats to the second plane, and he tells us that both planes fly great with O.S. .70 Surpass engines swinging Master Airscrew 12x8 props. Electronics are courtesy of Futaba. He says that his club, the West Hickory Aero Modelers, makes weekly forays to his home to fly floatplanes on lovely Lake Hickory (visible behind the models). In Eddie's opinion, "Every RC modeler should try water flying!"

TWIN AVISTAR
Al Clark
Rockville Centre, NY

Seeing double? Well ... yes. Al says his twin Avistar "... flies absolutely neutral, and it's very hard to judge which plane is up and which is down." He adds that landings are touchy and must be on a runway; otherwise, the plane (which Al has dubbed "Mirror Image") is prone to flip and break its props. It's ... we can't resist ... two! two! Two planes in one!

¼-SCALE BÜCKER 133C JUNGMEISTER
Andrew Gibson
Jacksonville, FL

Built from a Dave Platt kit, Andrew's ¼-scale bipe has a 65-inch wingspan, weighs 13 pounds and is powered by a YS 1.20 4-cycle engine swinging a 16x10 APC prop. It features a full pilot figure, a completely detailed cockpit and more than 23 leather parts. Its scale half doors are functional, and Andrew says the plane flies great.



15TH ANNUAL ARIZONA

STORY & PHOTOS BY RICK BELL

A HOTBED OF JET ACTIVITY

Close your eyes and imagine a paved runway that's 800 feet long and 85 feet wide. Then imagine a pavilion with plenty of worktables that stretches 250 feet and provides comfortable shade from the ever-present sun. While you're at it, place this flying site in an area that has more air space than you'll ever need and a climate that allows modelers to fly year round. Sounds like heaven, doesn't it?

Well, this flying site does exist in Mesa, AZ. It's the Superstition Airpark, home of the Arizona Model Aviators, where the 15th annual Arizona Jet Rally took place last November. When I arrived, the sky was a brilliant blue and the temperature was in the high 70s—a welcome change from the cold and snow that Connecticut was experiencing. So it did, indeed, feel as though I were in heaven! Not only was the weather awesome, but so was the flying, with many spectacular jets in the air at all times.

Another BVM turbine-powered Bandit heads off into the wild blue yonder.

JET RALLY

Far left: this sharp-looking F-16 replicates a jet from the local Arizona National Guard unit. In the air, it was impossible to tell whether it was a model or the real thing. Second from left: here, a turbine-powered Eurosport cuts up the sky with an inverted pass for the spectators. They loved it! Third from left: the pit area was always a beehive of activity. Left: this ducted-fan Jet Hangar Hobbies Hawk quietly awaits its flight in the ready box.

Right: how's this for a low pass! The TamJets team put on quite a show. Below: Ken Wagner's Aeroloft Designs F-104 Starfighter heads out on an exciting flight. It was really spectacular.

Right: do you think the flame paint job on this Bobcat reflects its speed potential? Below: the TamJet team of (left to right) John Orito, Ehab Aljandali and Tam Nguyen take a quick timeout from their flying for a photo. This was the only time they were motionless during the event.

ON THE TARMAC

It had been many years since I had attended an all-jet event. True turbines in models were unheard of then but were talked about often. Ducted-fan models had just started to achieve real performance, and electric jet models were considered impossible. Boy, have things changed! Turbine-powered models are now commonplace for true jet performance and have all but replaced glow-powered ducted-fan models. In fact, electric jets outnumbered glow-powered ducted-fan models at the Jet Rally by almost 3 to 1!

This year, 77 pilots brought more than 100 jet models of all types and sizes, including sport and scale. I don't know whether anyone kept a log of flights flown, but throughout the three-day event, there were very few moments during which at least two jets weren't lighting the fires! Many impressive models were on hand—some nothing short of spectacular, and Ken Wagner's Aeroloft Designs F-104 Starfighter attracted the most attention. When it first appeared in the mid-1950s, the F-104, with its futuristic look, small wing and needle nose, earned the nickname of "Missile with a man in it." The F-104 was the first operational interceptor capable of sustained speeds above Mach 2.0 and was the first aircraft to hold the world speed and altitude records simultaneously. Though Ken's jet is large at 1/7 scale, it spans only 44½ inches and is 94 inches long, and it's powered by a RAm 500 turbine.

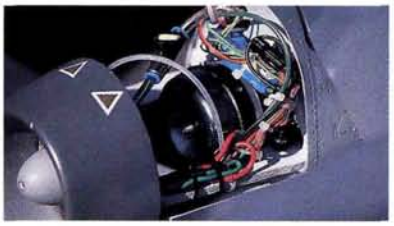
When Ken readied this beauty for flight and fired up the turbine, rest assured that he owned the flightline! Everyone watched as he taxied the jet onto the runway, turned it into the prevailing wind and quickly accelerated. Even though the F-104 looks as if it shouldn't be able to fly with its impossibly small wing, the jet gracefully lifted off and convincingly climbed away as the gear retracted. After a few passes and with the fuel load quickly decreasing, the Starfighter really came to life as it streaked across the Arizona sky. A huge cheer from spectators and pilots erupted when Ken skillfully landed the jet and taxied it back to the pits. What a breathtaking flight!

This was only the beginning of many spectacular flights, as TamJets' Tam Nguyen and his team demonstrated what their ViperJet MK IIs could do. It seemed that every time you turned around, a ViperJet MK II was airborne. Their flights were outstanding, especially when they turned on the smoke. Very cool!

By far the most popular jets on the scene were BVM's BobCats and the new, larger, KingCat. Both jets are cool looking and excellent flying models. The KingCat has a very wide performance envelope, and I was quite impressed to see one land at a walking pace with a 3-foot rollout.

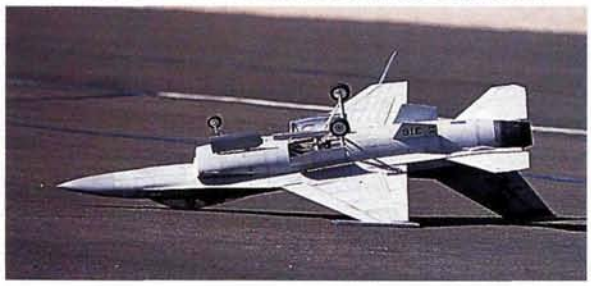
LETHAL LUFTWAFFE FIGHTER

Joe Balabon came all the way from New Jersey to fly his Airworld Me-262 and did a very credible job. The Luftwaffe fighter spans 80 inches, weighs 22 pounds and is powered by twin Wren 44 turbines that produce 7 pounds of thrust each. The German fighter, nicknamed "Schwalbe" (swallow), put in a couple of very impressive flights. Joe used Jet Hangar Hobbies' Wren 44 turbines to power his jet.



SCALE SPEEDSTERS

All three days of the event were bright and sunny, but temperatures on Saturday and Sunday fell to the lower 50s, and the wind steadily increased. This, however, didn't deter the scale jocks from taking to the air with a great variety of jets: F-16 Fighting Falcons, F-15 Eagles, F/A-18 Hornets, F-86 Sabres were just a few of the scale beauties. The wind did play havoc with models that had narrow-track landing gear; when these turned crosswind, a badly timed gust could lift and drag a wingtip, or worse—flip them completely over. F-16s were the most vulnerable to these conditions.



As this F-16 demonstrates, heavy crosswinds played havoc with narrow-tracked models. Damage was minor, though.

AWARDS

Even though this was only a "fun fly," no fewer than 13 awards were given out at the end of Sunday's activities. The decisions were difficult, as many beautiful models and realistic flights deserved recognition. Here's how things stacked up.

AWARD	RECIPIENT	MODEL
Best Boeing Jet	Charlie Beverson	A-4 Skyhawk
Best Graphics	Kenny Falconer	Rookie
Best Electric Jet Performance	Ed Waldrep	F-18 Hornet
Best Finish	Duff Waldron	Bandit
Best Scale Flight (ducted fan)	Austin Goodwin	BAe Hawk
Best Scale Flight (electric)	Marty Snell	Learjet 31A
Best Scale Flight (turbine)	Joe Balabon	Me-262
Pilot Choice (ducted fan)	Ron Werner	Bandit
Pilot Choice (electric)	Patrick Richards	BAe 146
Pilot Choice (turbine)	Ehab Aljandali	ViperJet MK II
Peoples Choice (1st)	Nick Robinson	F-9F5 Panther
Peoples Choice (2nd)	Kenny Falconer	Rookie
Peoples Choice (3rd)	Ron Werner	Bandit

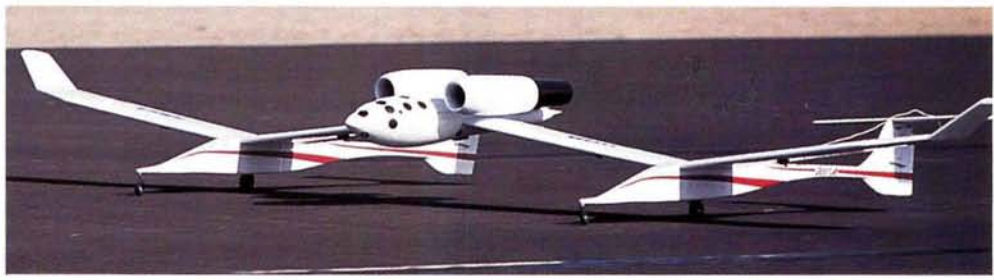
"Watts Up" With Electric Jets

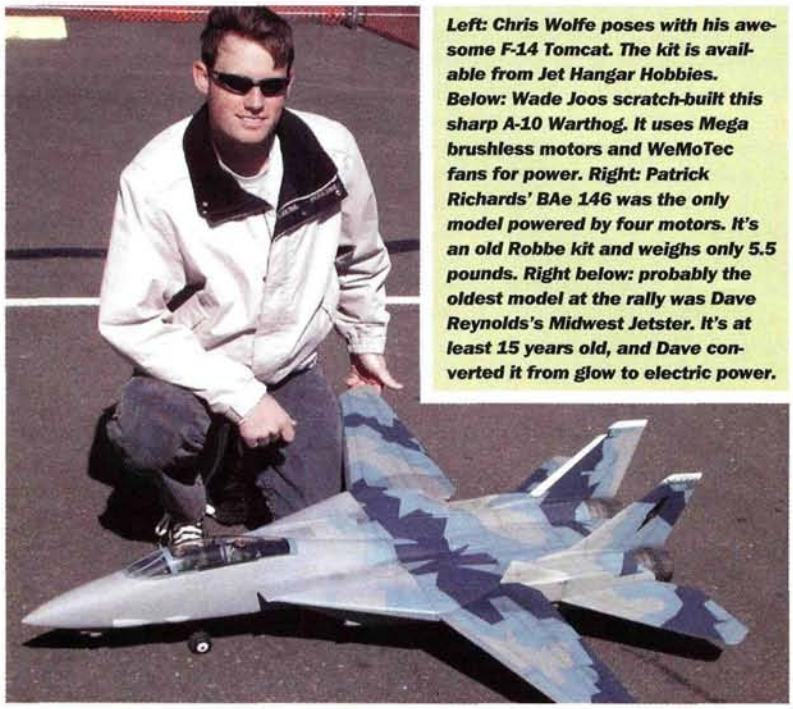
One of the biggest surprises was the large number and huge variety of electric ducted-fan (EDF) jets. They ranged from small jet-like models to converted glow-powered warbirds to a scratch-built, 137-inch-span model of Burt Rutan's X-Prize contender White Knight. These models and more made many flights despite the strong wind.

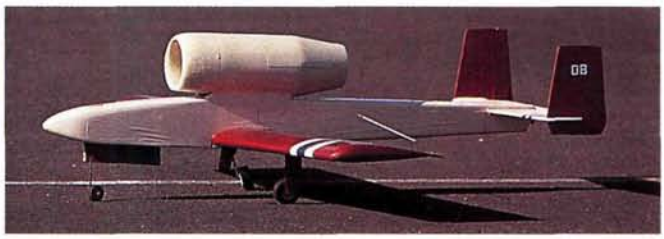
Given the sizable contingent of EDFs present, I'd say that their development is at the stage where glow-powered ducted-fan jets were when they first appeared on the scene. What makes this segment so popular is the latest batch of high-performance brushless motors from Hacker, Mega and AstroFlight and a host of other manufacturers. The other part of the equation is the power source: the all-important battery. Lithium-polymer (Li-poly) batteries, though in their infancy, are playing a key role and are showing vast improvement as they mature. The EDFs at this year's event certainly generated a lot of interest with their increased performance and duration. Here are some of the highlights:

GREG MOORE's EDF certainly was the most ambitious one I've ever

Above: this is the prototype for what is now the Electric Jet Factory Bob-E-Cat kit. Left: here's Wade Joos's Learjet 31 rotating on its takeoff run. It flew great! Below: Greg Moore's White Knight is scratch-built, spans 137 inches and weighs 16.5 pounds. There are two Hacker 77/3P brushless motors in the nacelles, and they provide ample power for the White Knight.







Left: Chris Wolfe poses with his awesome F-14 Tomcat. The kit is available from Jet Hangar Hobbies. Below: Wade Joos scratch-built this sharp A-10 Warthog. It uses Mega brushless motors and WeMoTec fans for power. Right: Patrick Richards' BAe 146 was the only model powered by four motors. It's an old Robbe kit and weighs only 5.5 pounds. Right below: probably the oldest model at the rally was Dave Reynolds's Midwest Jetster. It's at least 15 years old, and Dave converted it from glow to electric power.

seen. Spanning 137 inches, his White Knight weighs 16.5 pounds and uses two WeMoTec Midi fans. Hacker 77/3P brushless motors powered by two, 30-cell 1950mAh NiMH battery packs provide the thrust. Greg braved the winds and thrilled us all when he got the Knight airborne. For a moment, you'd have sworn you were at Burt Rutan's Scaled Composites secret research center watching the maiden flight of the real thing.

HOW'S THIS for an oldie but goodie: an old Midwest Jetster (above) that has been converted to electric power? Dave Reynolds' model is at least 15 years old, but you'd never have known it by the way it flew. The Jetster uses a WeMoTec Midi fan and a Hacker brushless motor, and Dave says that the model flies way better now that it's electric powered.

CHRIS WOLFE of Jet Hangar Hobbies showed his superb F-14 Tomcat (top right). Two AstroFlight 05 motors and WeMoTec Mini fans power this breathtaking fighter. The model is unique in that, just like the full-scale aircraft, the wings can be swept back during flight. Spring Air mini retracts add that final touch of realism. Check out that paint scheme; it's authentic.

WADE JOOS hails from Salt Lake City, UT, and he's a one-man air force. He brought no fewer than six spectacular models to the rally, but most impressive was his Learjet 31 (left center). Designed by Wade's buddy Marty Snell, the Learjet was an amazing sight as it winged its way around the clear blue sky. The Lear features a composite fuselage and nacelles and foam-core wing and tail. The jet spans 68 inches and weighs 10½ pounds. Two Hacker B50 13L brushless motors mated to WeMoTec Midi fans and two, 20-cell 2600mAh battery packs provide spirited motivation.

SPONSORS

No event of this size would be possible without the help of sponsors, and the Arizona Model Aviators gratefully acknowledge the companies that generously donated prizes. This year, a few thousand dollars' worth of goodies were handed out to many happy recipients.

Aeroloft Designs
Aerospace Composite Products
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Bob Violett Models
Cermark
D&D Hobbies
Electric Jet Factory
EMS
Frank Tiano Enterprises
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Hobby Town of Gilbert
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Jet Hangar Hobbies
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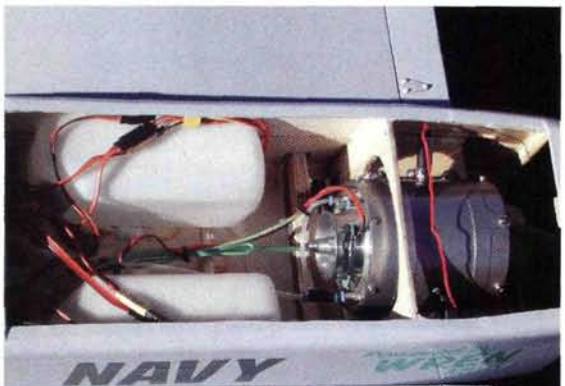
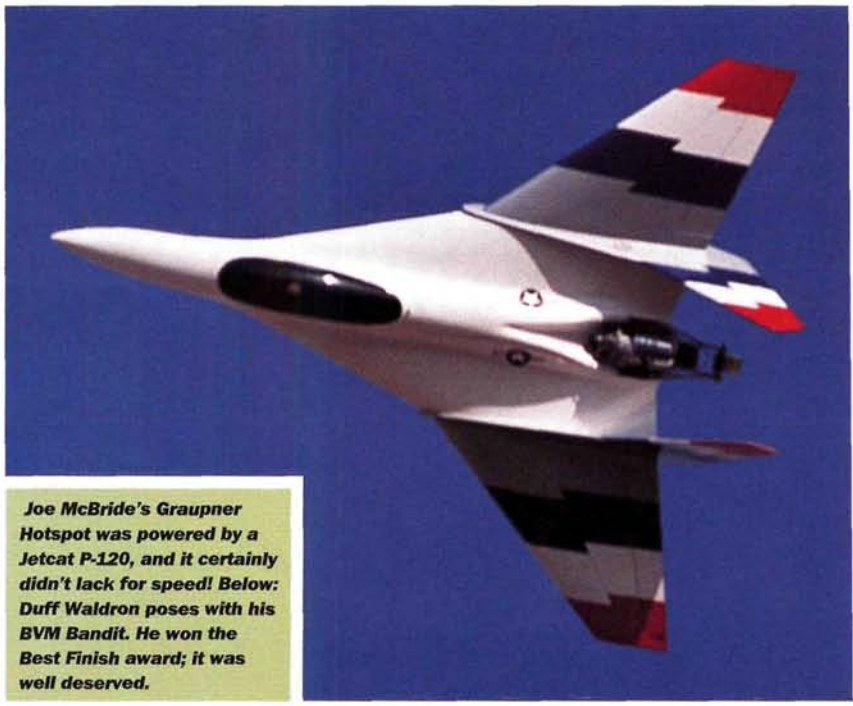
McCoy Glow Plugs
Model Airplane News
Propwash Video Productions
RCM magazine
Steve Jets
TamJets
Tower Hobbies
Viper Hobbies

EZ TURBINE TRAINER

Mike Thomson flies a full-scale Citation 10 jet professionally and is also a very innovative modeler. Having watched turbine models (and their costs) develop over the years, he wanted to re-create his turbine experience in a simple model. He decided that an uncomplicated, low-cost and easy-to-build turbine trainer model would satisfy his needs. He wanted a model that had easy interior access, a wide speed envelope and solid flight characteristics. One day in a restaurant during a layover, Mike—like many other modelers—doodled a rough design on a paper napkin. From there, he refined the design and started cutting wood. Using conventional building materials and techniques, Mike's built-up trainer uses mostly balsa for the sheeted fuselage, tail booms and vertical fins. The wing and stabilizer are foam-cores sheeted with balsa. A Wren 54 that produces 12 pounds of thrust provides power. After watching Mike fly the model at the rally, I'd say that he met his goals. The model flew very fast (around 190mph), yet it slowed down nicely for landings. Mike has had many requests for a kit, and rumor has it that he's contemplating the idea.



Top: Mike Thompson's scratch-built turbine trainer was a fine-flying model. It was rumored on the flightline that he might offer it as a kit. Above: the engine installation in Mike's trainer is simple, uncluttered and clean—makes for easy maintenance!



Joe McBride's Graupner Hotspot was powered by a Jetcat P-120, and it certainly didn't lack for speed! Below: Duff Waldron poses with his BVM Bandit. He won the Best Finish award; it was well deserved.

FLIGHT CREW

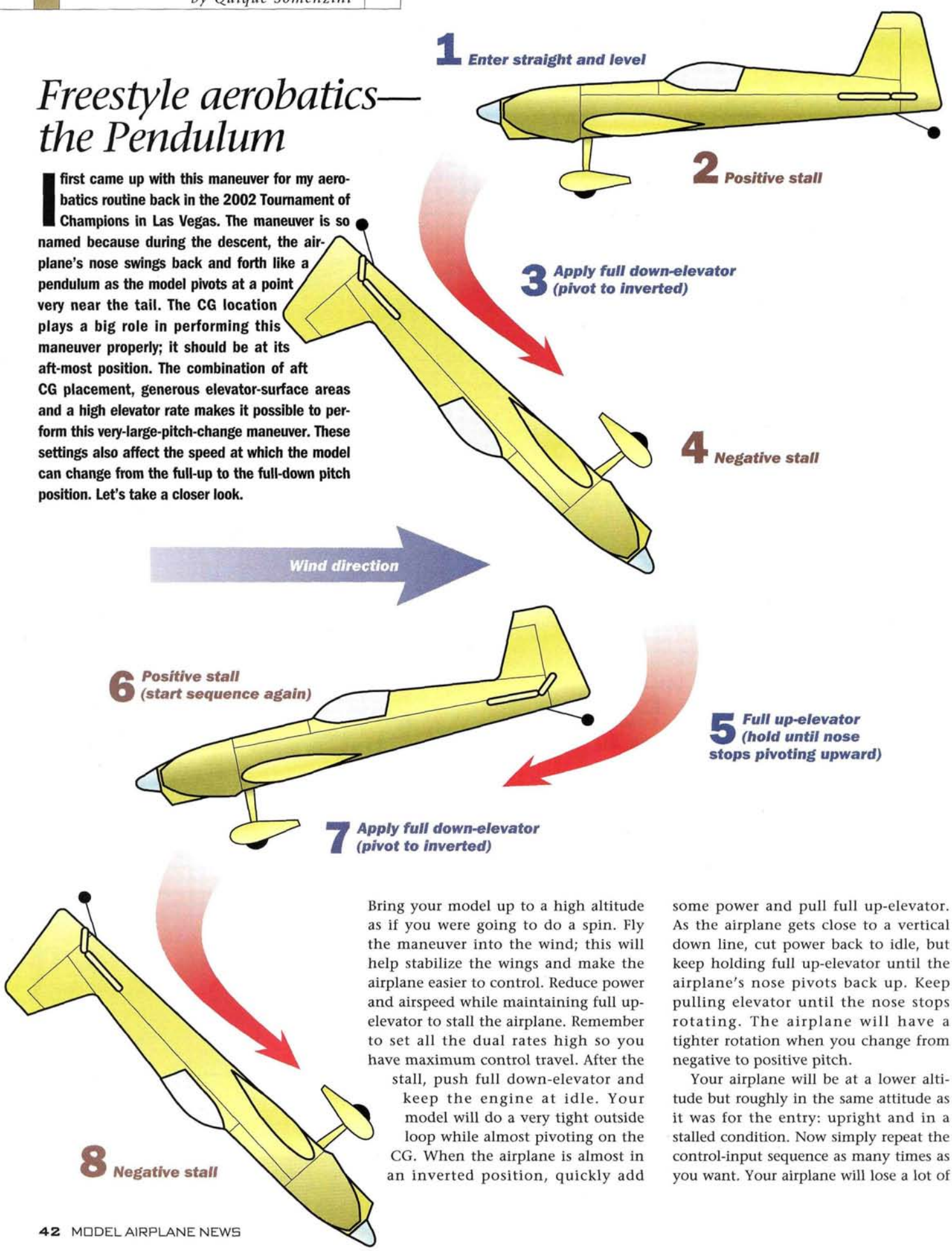
No event of this size can run as smoothly or as safely as this one did without the efforts of many hard-working people. Congratulations to CD Bob Ruff and his crew on a very well-coordinated event; everyone who helped, from the radio impound attendants to the flightline safety officers, created an atmosphere in which the participants were able to fly as much as they wanted without any incidents—a testament to a well-oiled machine and the high proficiency of the pilots.

Despite the unusually cool weather, the rally was a great success. Superstition Airpark, with its smooth paved runway and fantastic views, is a superb site for jet operations. Judging from the large turnout of pilots and spectators, this event will surely continue to be a "must-attend" for jet-minded modelers.

by Quique Somenzini

Freestyle aerobatics—the Pendulum

I first came up with this maneuver for my aerobatics routine back in the 2002 Tournament of Champions in Las Vegas. The maneuver is so named because during the descent, the airplane's nose swings back and forth like a pendulum as the model pivots at a point very near the tail. The CG location plays a big role in performing this maneuver properly; it should be at its aft-most position. The combination of aft CG placement, generous elevator-surface areas and a high elevator rate makes it possible to perform this very-large-pitch-change maneuver. These settings also affect the speed at which the model can change from the full-up to the full-down pitch position. Let's take a closer look.



Bring your model up to a high altitude as if you were going to do a spin. Fly the maneuver into the wind; this will help stabilize the wings and make the airplane easier to control. Reduce power and airspeed while maintaining full up-elevator to stall the airplane. Remember to set all the dual rates high so you have maximum control travel. After the stall, push full down-elevator and keep the engine at idle. Your model will do a very tight outside loop while almost pivoting on the CG. When the airplane is almost in an inverted position, quickly add some power and pull full up-elevator. As the airplane gets close to a vertical down line, cut power back to idle, but keep holding full up-elevator until the airplane's nose pivots back up. Keep pulling elevator until the nose stops rotating. The airplane will have a tighter rotation when you change from negative to positive pitch.

Your airplane will be at a lower altitude but roughly in the same attitude as it was for the entry: upright and in a stalled condition. Now simply repeat the control-input sequence as many times as you want. Your airplane will lose a lot of

PROPERLY USING RUDDER AND AILERON WILL MAKE YOUR MANEUVERS SMOOTHER. NOTE THE ELEVATOR DEFLECTION—A KEY POINT IN THE PENDULUM.

altitude, so keep an eye on the ground and estimate a safe recovery altitude.

To make the maneuver look very smooth, keep the roll and yaw movements to a minimum. While applying up- and down-elevator, keep your wings level with ailerons and correct for the engine torque with rudder. Since the airplane's wing stalls several times during this maneuver, it is helpful to have an airplane that remains stable in a stall.

A good way to exit this maneuver is to bring the nose up and then go to a torque roll. Add full power and pull up-elevator until the airplane is in a vertical up line. Reduce the power to enter a hover, then do the torque roll.

The pendulum is a fun maneuver that's relatively easy to do. Set up your airplane correctly, and practice at high altitude until you perfect the control inputs; you'll know when it feels right.

MORE FLIGHT MODES

In the February 2004 issue, I explained how convenient it is to use your computer radio's "Flight Mode" switch to manage the five flight groups and get the most out of your 3D aircraft. I already discussed general flight, so this time, let's look at the snap roll.

A big consideration for how you set up your model is how you manage your servo-to-receiver connections and whether or not you use special mixing. Since some competition rules allow mixing and others do not, I keep it simple and use only a standard setup. I don't use mixing to improve my aerobatics! If you do use mixing (elevator to flap, flaperons, aileron to elevator, etc.), turn the mixing off for snap rolls.

SNAP-ROLL FLIGHT MODE

When done properly, the snap roll is a beautiful maneuver. It is also quick—probably the quickest to execute in the Aresti catalog. Basically, it is a high-speed stall while the model rotates around its main centerline. The airplane rolls, pitches and yaws all at the same time. Snap rolls can be either positive or negative, depending on whether you pull (up) or push (down) the elevator stick. Competition rules do not allow the use of a snap-roll switch, so you need to learn how to set up your model to snap roll it consistently. The control inputs are:

- **Positive left snap roll** (left aileron, up-elevator, left rudder)
- **Positive right snap roll** (right aileron, up-elevator, right rudder)
- **Negative left snap roll** (left aileron, down-elevator, right rudder)
- **Negative right snap roll** (right aileron, down-elevator, left rudder)

Note that with negative snap rolls, rudder input is opposite to the direction of the ailerons. Aileron always controls the rotation direction.

To do all four types of snap rolls with precision, you must adjust the rates for aileron, rudder and elevator, so you can perform them consistently. Starting from the general flight-mode settings, most airplanes will require increased aileron, reduced rudder and slightly increased elevator rates. Once you assign the flight mode to your favorite switch, start with the general flight group settings and adjust them to the following settings:

- **Aileron** 100%
- **Rudder** 50%
- **Elevator** 30%

These are good starting points and, of course, will need to be fine-tuned for various airplanes.

Without flight-mode settings, it is possible to set up your model by adjusting its high and low rates. Use low rate for the general flight settings and high rate for the snap-roll settings. If you have only dual-rate adjustment for elevator and aileron, adjust your rudder throw to a rate that will work best for all your maneuvers. As I've said before, it is possible to do nice snap rolls without dual rates and at the same time do all the Aresti and 3D maneuvers, but it will be very hard to fly in a consistent manner.

That's it for now! Go out, practice your 3D maneuvers, and have fun!

IF YOU DO USE MIXING (ELEVATOR TO FLAP, FLAPERONS, AILERON TO ELEVATOR, ETC.), TURN THE MIXING OFF FOR SNAP ROLLS.

GREAT PLANES Christen

1/3-scale showstopper

Eagle II

Story & photos by John Reid

The Christen Eagle II was one of the best flying aerobatic biplanes ever built. I knew that Great Planes would stay true to the plane's scale outline and style, but would this model be an outstanding aerobatic performer? Well, I'm happy to say that it is! The Great Planes Christen Eagle II has the same great looks as the full-size aircraft and a fantastic color scheme, and it is the easiest-to-fly biplane I have ever flown. It can tumble across the sky in aerobatic gyrations that would make even a diehard Edge 540 or Extra 330 pilot smile. It's definitely a plane that you will never get tired of flying.

OPENING THE BOX

All four wing halves and the tail feathers arrive wrapped in plastic and protected by bubble wrap. Accessories include the canopy, landing gear, wheel pants, cabane and wing struts, flying wires with metal brackets, tail-gear assembly, tank, engine mount, decal sheet and spinner. The hardware package includes just about everything you need for assembly. A 51-page instruction manual gives details for mounting three types of engine (one glow and two gas) and for installing the flying wires.

CONSTRUCTION

• **Wing assembly.** Following the instructions, I started with the wings, which took only an evening to complete. The bottom wing joiners have to be glued together with 30-minute epoxy; while the glue was curing, I removed all the wrinkles in the wing covering. The next step was to install the four ailerons; this went quite fast. No real tricks here: insert T-pins through the middle of the hinges, slide them into the hinge slots, apply six to eight drops of thin CA and let it dry.

When I test-fit the wing panels, I adjusted the wing joiners by sanding them with a sanding block. When I was satisfied with their fit, I mixed 30-minute epoxy, applied it to the wing roots and joiners and then pushed the wing halves together. The manual shows a great idea for wiping away the excess epoxy that oozes out of the joint. Cut small squares of paper towel (eight per sheet), and use these and rubbing alcohol to clean off the excess epoxy. When the joint was clean, I used strips of masking tape to hold the wing halves together until the glue had cured.

The upper wing assembly is completed in the same way as the lower wing, but the wing halves are attached to a center section. When you epoxy everything together, be careful to ensure that you don't glue the string that you'll use to pull the servo wires through the wing to the inside of the panels. To avoid doing this, pull the string back and forth a few times as the epoxy dries. I was somewhat negligent and allowed one string to become firmly attached to the inside of the wing. Don't let this happen to you.

With both wings assembled, all I had to do was install the control horns and the

It's a good idea to install the aileron servos before you screw the control horns into place. By doing this, you'll ensure that the pushrod alignment doesn't bind.

SPECIFICATIONS

MODEL: Christen Eagle II

MANUFACTURER: Great Planes Model Mfg. Co.

TYPE: giant-scale sport-scale ARF

WINGSPAN: 68.5 in.

WING AREA: 1,436 sq. in.

WEIGHT: 18 lb.

WING LOADING: 29 oz./sq. ft.

LENGTH: 62.5 in.

ENGINE REQ'D: 1.6 to 2.2ci 2-stroke, 1.8 to 3ci 4-stroke, or 2.0 to 3.2ci gas

ENGINE USED: Fuji BT-50SA

RADIO REQ'D: 4-channel with 8 servos (ailerons [4], elevators [2], rudder, throttle)

RADIO USED: Airtronics RD8000 with 5-94322 (ailerons, throttle), 2-94751 (elevator), 1-94731 (rudder)

PROP USED: Top Flite Power Point 20x8

PRICE: $399.99

FEATURES: all balsa and plywood construction with MonoKote covering; factory-built wings, fuselage and tail surfaces; painted fiberglass cowl, wheel pants and wing struts; aluminum spinner, landing gear and cabane; engine mount, fuel tank, wheels, plastic canopy, high-quality hardware package and a comprehensive assembly manual.

COMMENTS: this plane rocks! This very easy-to-build, giant-scale, fully aerobatic biplane really gets your heart pounding. Outstanding craftsmanship is evident in everything from the construction to the color scheme. All the parts fit together well, and with the included, high-quality hardware package, you won't have to go to the hobby store to buy parts upgrades. For outstanding looks and performance, this plane is hard to beat!

HITS

- Beautiful color scheme.
- Easy to build.
- Includes scale flying wires.
- Flies great!

MISSES

- None.

servos and hook the linkage up to the ailerons. Again, this took much less time than I had anticipated; I finished both wings in just one evening.

• **Fuselage.** Assembly begins with the tail feathers. I removed the MonoKote from the cutouts for the stabilizer and servos. I put the rudder and elevator servos in the cutouts and drilled the screw holes. Then I removed the servos, and I added a few drops of thin CA to strengthen the holes. I squared up the stabilizer with the fuselage and bottom wing. With everything lined up, I marked the stabilizer and removed the covering from its center section. Using 20-minute epoxy, I set the stabilizer back into place, cleaned off the excess epoxy and rechecked the alignment. Once the epoxy had hardened, I attached the fin using the same process, making sure that it was at 90 degrees to the stabilizer. With the tail feathers installed, I moved on to installing the engine.

As you can see, this Christen Eagle is a great-looking plane ...

• **Engine and cowl.** I installed a Fuji BT-50SA gas engine following the manual's instructions for that type of engine It was easy: cut out the mount pattern, line it up with the scribe marks on the firewall and tape it down. Drill the holes where indicated and mount the engine. I did eat up some time installing a bellcrank for the throttle, but the newer Fuji-BT-50SB engines have the throttle arm in a better position on the carburetor that allows a straight shot on the pushrod. No matter which type of engine you use, don't use a metal pushrod for the link to the servo.

Mounting the cowl was next; the plywood-cowl-ring mounting system really makes for a slick installation. Screw the ring to the fuselage with five 4-40 bolts, slip the cowl over the ring, and line it up with the fuselage and the spinner. When I was satisfied with the alignment, I put six large drops of epoxy around the ring where it meets the cowl. After the epoxy had hardened, I removed the cowl and reinforced the joint with epoxy, microballoons and fiberglass strips. The cowl is attached with five bolts from the inside—a nice, clean installation. The plywood ring also greatly strengthens the cowl. Great Planes includes an extended

Bird of a different feather

With fabric feathers and 200hp in its beak, the Eagle II was Californian Frank Christensen's idea of what a two-place, good-time flying machine should look and fly like. A slicked-up city cousin of the Pitts Special, the Eagle has a following of enthusiasts who are every bit as rabid about their airplane as the Pitts Special crazies are about theirs.

The truth is that the Eagle owes more than a little to the S-2A Pitts because in the early 1970s, Christensen bought a bare Pitts S-2A airframe from the factory to modify it to his own liking. He was a serious aerobatic pilot, but more than that, he was the epitome of the entrepreneur; in fact, he became a millionaire right out of college because of a few electronic gadgets he invented while in school. So, as he began to modify the Pitts, his mind took off in another direction, and he decided the homebuilt world needed a new two-place biplane design. The Eagle concept and Christen Industries were born.

Christensen hung his modified Pitts on the wall of his well-equipped workshop and never finished it. The resulting Eagle homebuilt kits (now among Aviat Aircraft's offerings) are still the standard against which all other kits are measured.

His design work was aimed at avoiding all the Pitts's shortcomings. Christensen is a pretty big guy, and the first thing on his gotta-be-changed list was the cockpit: he widened it slightly, moved most of the instruments to the front panel and almost eliminated the rear panel altogether. He also eliminated the cockpit sheet metal above the longerons; this traditionally curved inward and made the pilot and passenger feel like prairie dogs peeking out of their burrow. He capped the entire thing off with a wide, high, bubble canopy. The result was greatly increased creature comfort and better in-flight visibility.

The Pitts has an undeserved reputation for being pretty snaky on the ground, and Christensen's approach to that was to replace the super-stiff bungee landing gear with a more modern, spring-type gear. The new gear softened the swerving, and that reduced the airplane's ability to scare the devil out of the pilot by making it more mannerly on the ground. The sleeker gear legs also got rid of a lot of aerodynamic drag.

Christensen had a good eye for design as well as performance, and he laid out an entirely new cowl that works with the cleaner landing gear to make the Eagle a solid 15 to 20mph faster than the S-2A with the same engine.

Of course, an Eagle without the distinctive multicolored feather motif wouldn't be an Eagle. Christensen always paid attention to marketing, so he had a paint scheme designed that few would even attempt to duplicate on anything but an Eagle; in fact, he copyrighted it, and those who put the same scheme on another airplane could count on a "nastygram" from Christen Industries' legal department.

From a pilot's point of view, the Eagle II is exactly what Christensen wanted it to be: a slightly more civilized Pitts with no performance compromises. High-time Pitts pilots will point out that there is a subtle difference between the two in that the Pitts has a more "dense" feel it to it and grooves through maneuvers better, but you're splitting hairs at that level of performance.

Even now, 25 years after it was introduced, the Christen Eagle has to be one of the more recognizable—and one of the best flying—airplanes ever built.

—Budd Davisson

FLIGHT PERFORMANCE

Because I had balanced the Christen Eagle and adjusted its flying wires the night before I went to the field, I decided not to disassemble it for transportation. But stowing the plane in my van with its wings on was quite a challenge! I removed the van's four back seats and wedged the Eagle in without damaging it.

At the field, I checked to make sure that all of the connections with clevises were tight (there are 48 of them, counting the flying wires). I did a range check with the engine off and then with it running, and everything looked good. I tweaked the engine a bit, and then I was ready for the first flight.

TAKEOFF AND LANDING

Biplanes are generally considered to be real handfuls when it comes to ground-handling, but the Christen Eagle is an exception. The Fuji 50's torque with the 20x8 prop will cause the Eagle to veer to the left if you don't immediately add right rudder. To prevent this from happening, just add a little right rudder before you throttle up; this will keep the Eagle tracking straight and true. When the tail comes up, ease off the rudder so the plane doesn't veer to the right (the rudder is very effective). With just a little up-elevator, the plane jumps into the air and climbs out at a 20-degree angle. After reaching a comfortable altitude, I turned the plane back toward the field. The Eagle required only a little right trim and down-trim to achieve straight and level flight.

Landing is best done under power, although it isn't the end of the world if the engine quits. I throttled down to ½ on the downwind leg and to ¼ on base. On final, I had the engine at idle until just before the wheels touched, and then I throttled up just a little to prevent the plane from stalling and bouncing (the gear has a lot of spring). If you have to make a deadstick landing, just keep the nose down and the speed up. Flare out just before touchdown, and expect the plane to bounce a little.

LOW-SPEED PERFORMANCE

The Christen Eagle's low-speed performance is fantastic. When the throttle is reduced, the plane slows down very quickly, probably because of the drag induced by the flying wires. I was impressed by how slowly the plane can fly with great control, especially on high rates. When it does stall, the right wing drops slightly (I probably need better lateral balance; it's very predictable, however, and uneventful).

HIGH-SPEED PERFORMANCE

I like to have this large biplane make a low, high-speed pass and then pull up into a roll. Its controls are very precise and responsive at high speeds, and it tracks through the sky with precision. This plane has the high-speed flying characteristics of a pattern plane and the stable, low-speed flight of a trainer. It is quickly becoming one of my favorite flyers.

AEROBATICS

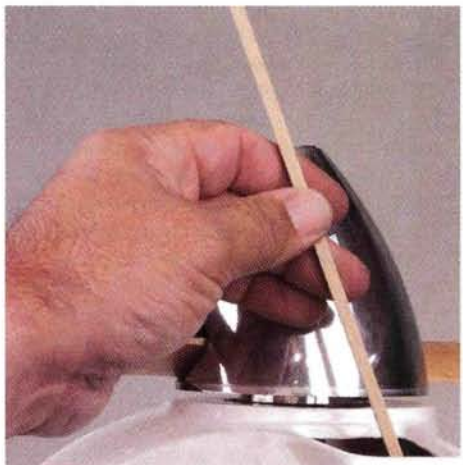
If you're looking for a fully aerobatic bipe, you'll appreciate the Christen Eagle. With the exception of certain high-angle 3D maneuvers, it will do any aerobatic maneuver you want it to. It excels at loops, rolls, spins, snaps, tail slides, hammerheads and everything else that you would expect from an aerobatic biplane. Once you start to fly this plane, you won't want to stop; it's that much fun.

hex wrench for cowl removal—a nice touch.

Next, I attached the landing gear and wheel pants: I screwed on the landing gear, fastened the gear fairings and mounted the wheel pants. To bulletproof your wheel pants, buy a 13x3⅜-inch swatch of Dave Brown Carbon Fiber Tape, and epoxy it to their insides. I highly recommend that you take the time to do this. You'll be very glad that you didn't skip this step.

While the Christen Eagle sat upside-down on the building stand, I installed the rudder and elevator servos. Each requires a 12-inch servo-extension lead that should be firmly secured at the connections with shrink-tubing, wire, or tape. After drilling the holes for the mounting bolts, I used the pushrod to line up the control horns. I again used thin CA to strengthen the perimeters of the holes. The rudder pushrod also controls the tailwheel, so I mounted it on the fuselage and connected the tailwheel to it. Because access was easy, I installed the fuel tank and hooked up the throttle at this time.

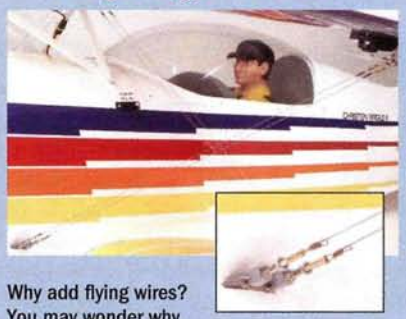
• **Final assembly.** I connected all the fuel lines to their respective fittings and made sure that they were secured in such a way that they would not come into contact with the engine or muffler. On the bottom of the plane, I mounted a kill switch that can be activated by a fifth channel; it will allow me to stop the engine in the air and on the ground. In an emergency, it can be very important to be able to shut off the engine during a flight. Take the time to hook a servo up to the kill switch.



After I had aligned the cowl properly, I used a long stick to apply epoxy to the plywood mounting ring.

After you've painted the cockpit and the pilot figure, apply the instrument-panel decals. Install the canopy with eight button-head screws, and for security, use clear tape or canopy glue as well. I added the brackets for the cabane and wing struts to the wings. If you elect not to add the optional flying wires, secure the receiver and battery in the fuselage and mount the

Flying Wires



Why add flying wires? You may wonder why you should add flying wires if they aren't necessary for structural integrity.

Add them if you:

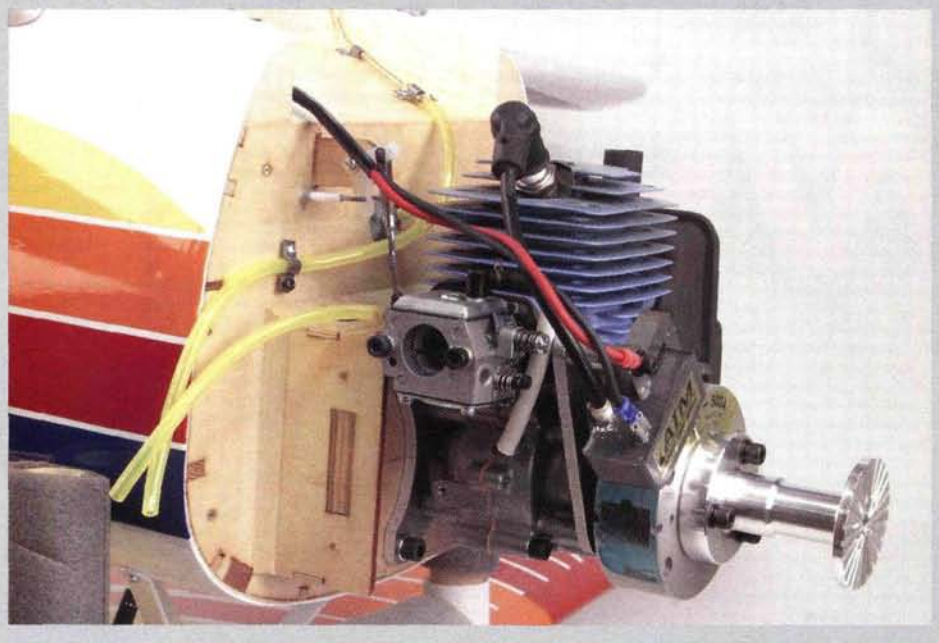
- don't like having parts left over when you've finished building a plane.
- want to maximize your plane's strength.
- enjoy scale looks.
- are more concerned with scale appearance than with aerobatics.
- have a vehicle in which you can transport the model fully assembled.

You may not want flying wires if you:

- like to finish every plane as soon as you can.
- don't like setting them up at the flying field.
- have a small car and will have to disassemble the plane at the end of the flying day.
- are more concerned with aerobatics than with scale appearance.

Fuji 50 Power

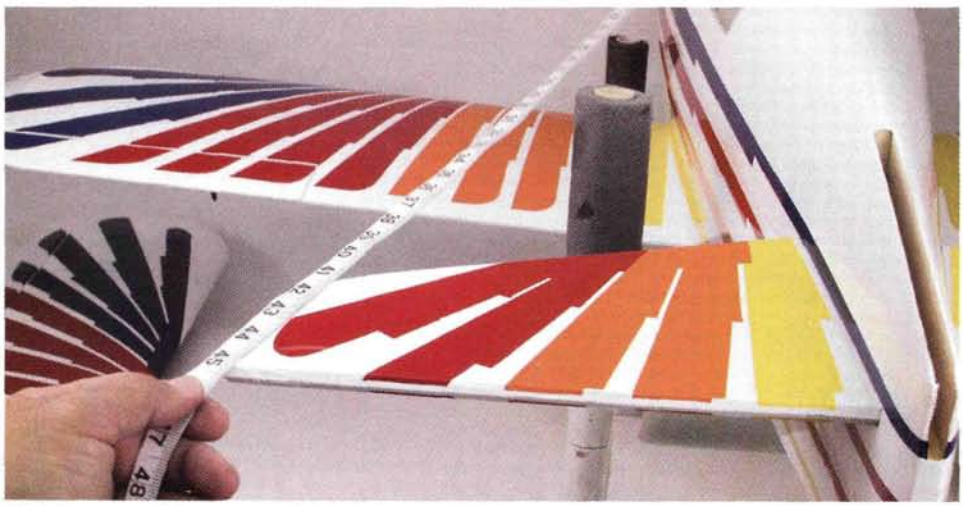
The Fuji 50 is a great running gasoline engine that's a perfect match for the Christen Eagle biplane. The engine is easily attached to the firewall using four ¼-20 or ¼-28 bolts, and the engine and stick muffler are a perfect fit inside the large engine cowl. Newer Fuji 50 engines come with a choke-equipped Walbro carb that has been repositioned so the throttle arm can be operated without the use of a 90-degree bellcrank.



MANUFACTURER'S SPECS
Engine: BT-50SB
Overall length: 216mm (8.5 in.)
Overall width: 140mm (5.5 in.)
Overall height: 191mm (7.5 in.)
Displacement: 46.5cc (2.84ci)
Bore: 32mm
Stroke: 43mm
Horsepower: 5.2 @ 10,000rpm
Rpm range: 1,200 to 10,000
Weight: 2.4kg (5.29 lb.) with muffler
Spark plug: Champion RCJ-6Y or 7Y gap 0.6mm (0.025 in.)
Propeller bolt: M8x1.25x40mm
Ignition type: CDI Automatic Ignition Timing
Magneto gap: 0.5mm (0.020 in.)
Price: $399.99

RECOMMENDED PROPELLERS/RPM READINGS
APC 18x10 (8,200 to 8,500rpm)
APC 18x12 (7,500 to 7,800rpm)
APC 20x8 (8,100 to 8,400rpm)
APC 20x10 (7,100 to 7,300rpm)

Fuel recommendations: use unleaded gasoline mixed with a high-quality, 2-cycle oil. For break-in, use a fuel mix of 25:1. Run for 1 hour with this mixture, then switch to a 40:1 mixture (3.25 ounces of 2-cycle oil to 1 gallon of gasoline).



With the measuring tape attached to the centerline of the fuselage, I checked to make sure that both sides of the stabilizer were the same distance from the center of the firewall before I removed the covering and epoxied it into place.

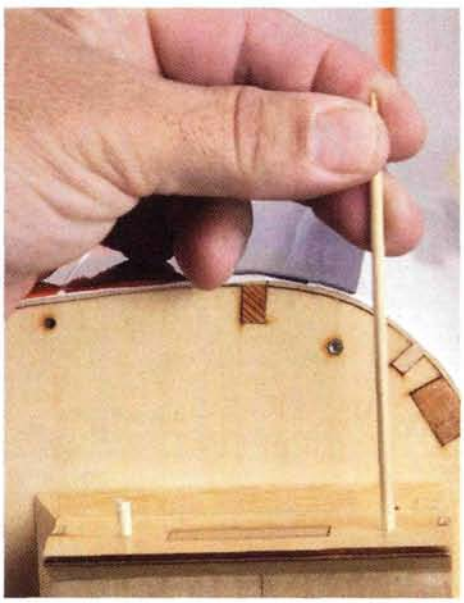
wings. Your Christen Eagle is finished.

I decided to add the optional flying wires because I like their true-to-scale looks. To do this, I had to install a number of brackets on the fuselage, tail surfaces and wings. I took the time to string the wires to each bracket and adjust their lengths to equalize the tension on both sides of the fuselage. Then I removed them and strengthened all the holes with CA or epoxy and brass tubes. This increased construction time, but I think it was time well spent.

I balanced the plane by moving the battery and receiver around inside the fuselage. I used GP's suggested control-throw settings. Last, I added the decals. My Eagle was ready to spread its wings!

FINAL THOUGHTS

As you can see, this Christen Eagle is a great-looking plane, but scale looks aren't the only thing it has going for it. Its outstanding flight envelope will give you plenty of hours of flying enjoyment. I love taking mine to the flying field, and I know you will, too.



When you install a large engine such as the Fuji 50, reinforce the firewall with wooden dowels (two per side, for a total of eight). Drill a hole in the sides of the firewall and insert a dowel that has some epoxy on it. When this has cured, sand the dowel so it's flush with the firewall.

Airtronics (714) 978-1895; airtronics.net.
Dave Brown Products (513) 738-1576; dbproducts.com.
Fuji Engines; distributed by Great Planes Model Distributors; fujiengines.com.
Great Planes Model Mfg. Co. (800) 682-8948; (217) 398-6300; greatplanes.com.
Top Flite; distributed by Great Planes Model Distributors; top-flite.com.

Lighting Technology for eye comfort

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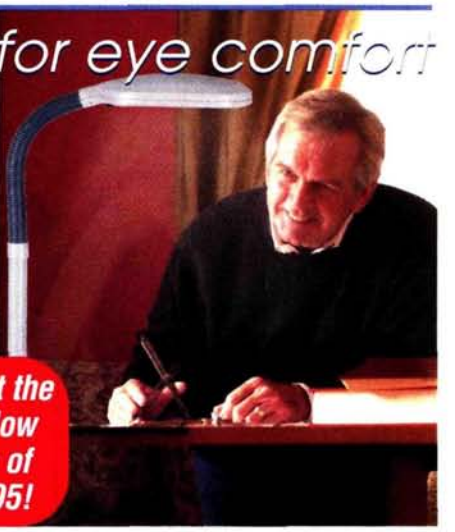
The Balanced Spectrum™ floor lamp brings many of the benefits of natural daylight indoors for glare-free lighting that's perfect for a variety of indoor activities...now available for under $100!



Now at the new low price of $99.95!

Ever since the first human went into a dark cave and built a fire, people have realized the importance of proper indoor lighting. Unfortunately, since Edison invented the light bulb, lighting technology has remained relatively prehistoric. Modern light fixtures do little to combat many symptoms of improper lighting, such as eyestrain, dryness or burning. As more and more of us spend longer hours in front of a computer monitor, the results are compounded. And the effects of indoor lighting are not necessarily limited to physical well being. Many people believe that the quantity and quality of light can play a part in one's mood and work performance. Now, there's a better way to bring the positive benefits of natural sunlight indoors.

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...for reading...

...at work...

...and when you need a source of natural light for close-up tasks.

The Balanced Spectrum™ floor lamp will change the way you see and feel about your living or work spaces. Studies show that sunshine can lift your mood and your energy levels, but as we all know the sun, unfortunately, does not always shine. So to bring the benefits of natural daylight indoors, use the floor lamp that simulates the full spectrum of daylight. You will see with more clarity and enjoyment as this lamp provides sharp visibility for close tasks and reduces eyestrain.

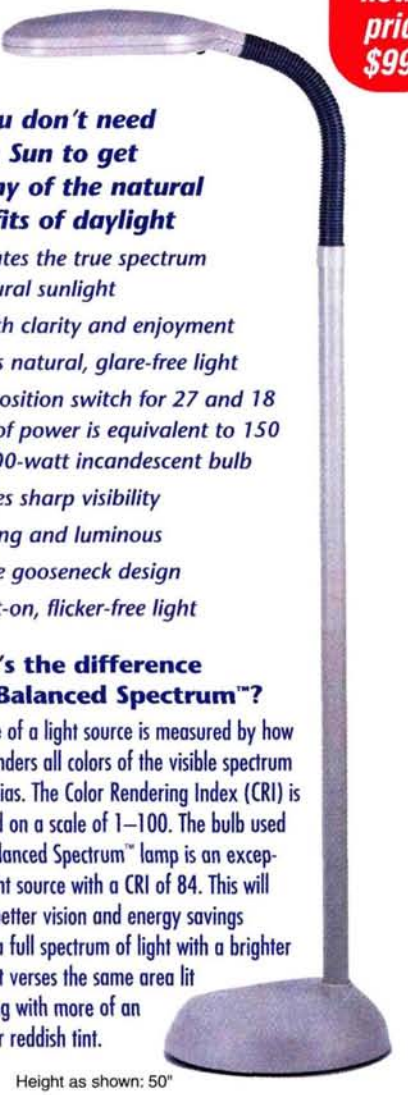
Its 27-watt compact bulb is the equivalent to a 150-watt ordinary light bulb. This makes it perfect for activities such as reading, writing, sewing, needlepoint, and especially for aging eyes.

You don't need the Sun to get many of the natural benefits of daylight

- *Replicates the true spectrum of natural sunlight*
- *See with clarity and enjoyment*
- *Creates natural, glare-free light*
- *Dual position switch for 27 and 18 watts of power is equivalent to 150 and 100-watt incandescent bulb*
- *Provides sharp visibility*
- *Elevating and luminous*
- *Flexible gooseneck design*
- *Instant-on, flicker-free light*

What's the difference with Balanced Spectrum™?

The value of a light source is measured by how well it renders all colors of the visible spectrum without bias. The Color Rendering Index (CRI) is measured on a scale of 1–100. The bulb used in the Balanced Spectrum™ lamp is an exceptional light source with a CRI of 84. This will provide better vision and energy savings through a full spectrum of light with a brighter bluish tint verses the same area lit by lighting with more of an orange or reddish tint.



Height as shown: 50"

We've looked at lots of lights, but this one offered the benefit of dual light levels of 27 and 18 watts of power equivalent to 150 and 100-watt incandescent bulbs. This lamp has a flexible gooseneck design for maximum efficiency, with an "Instant On" switch that is flicker-free. The high-tech electronics, user-friendly design, and bulb that lasts five times longer than an ordinary bulb make this product a must-have.

Try the Balanced Spectrum™ floor lamp with this special offer! Due to our overwhelming customer response, TechnoScout can offer this fantastic floor lamp for under a $100. The Balanced Spectrum™ floor lamp also comes with a one-year manufacturer's limited warranty and TechnoScout's exclusive home trial. Try this product for **60 days** and return it for the full product purchase price if not completely satisfied.

This light can change the way you live and work

As a commercial photographer, I probably give more attention to lighting than most people and therefore was impressed with the smooth, soft daylight quality of your lamp.

Dennis M.
Richmond, VA

I sit in my comfortable chair after my husband has gone to bed, and I turn that lamp on. It makes it so nice because it's like daylight over my chair...I don't get sore eyes like I used to.

Grace A.
Margate, FL

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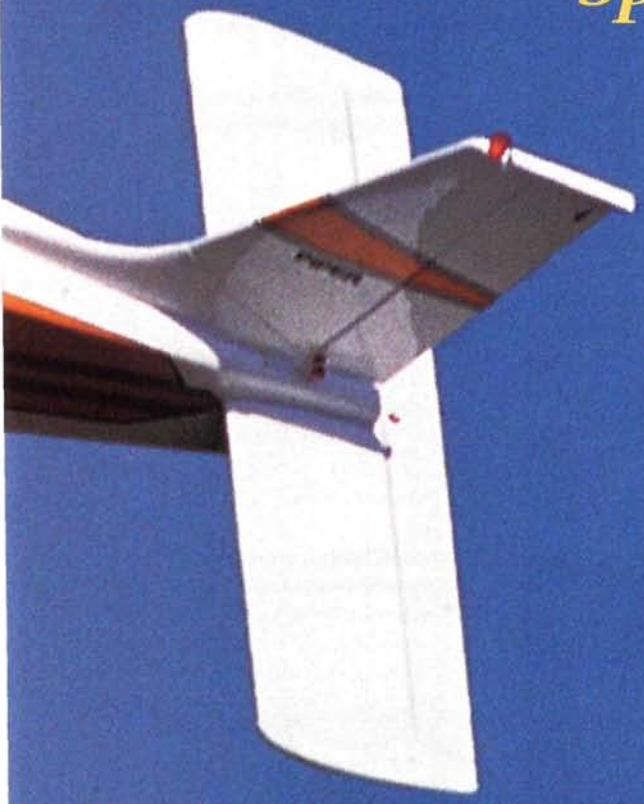
Piper Arrow 2

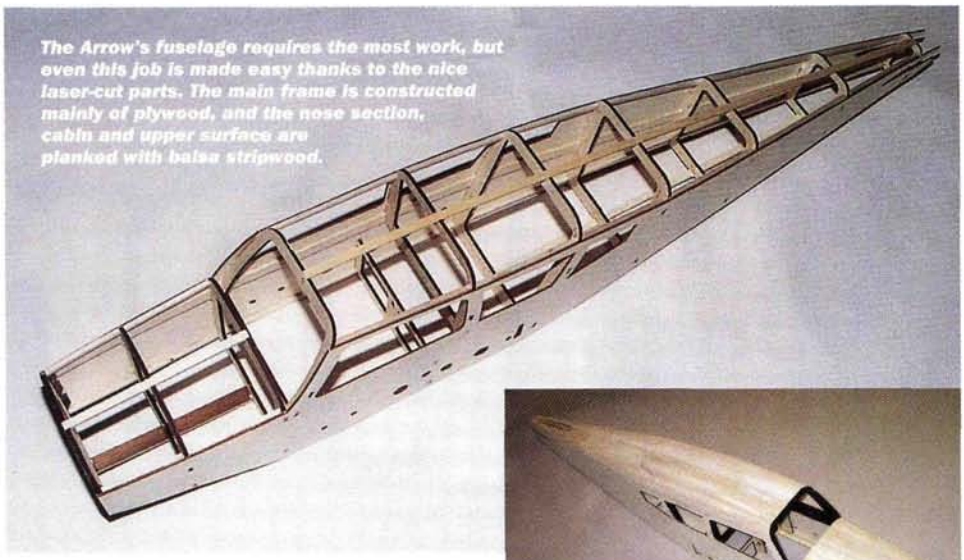
by Jim Onorato

Sport-scale sedan of the skies



The Piper Arrow 2 is one of the most rugged, reliable and attractive full-scale trainers in the air today. It offers the perfect combination of quality and features to make it suitable for training, business, commercial and private use. Its superior quality and reliability have made it a staple craft in Piper's fleet for 30 years. Popular worldwide with flight instructors, the Arrow is also an aircraft that flight school graduates often purchase for themselves. Since I am neither a flight school graduate nor wealthy enough to afford the full-size version, I was happy to try Aviomodelli's kit of this classic six-seater.

PHOTOS BY JIM ONORATO & DERON NEBLETT



The Arrow's fuselage requires the most work, but even this job is made easy thanks to the nice laser-cut parts. The main frame is constructed mainly of plywood, and the nose section, cabin and upper surface are planked with balsa stripwood.

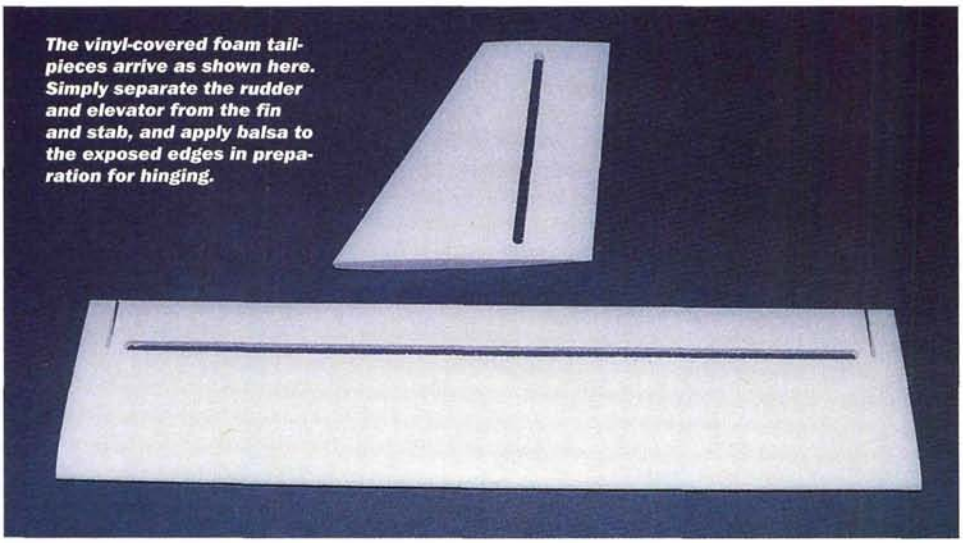
THE KIT

Though advertised as a 50-percent ARF, Aviomodelli's Piper Arrow 2 kit does require a fair amount of work. The Arrow is actually a balsa and ply kit with vinyl- (or resin-) covered, foam-core wings and tail feathers. The kit includes balsa and laser-cut ply parts for the fuselage, balsa stripwood, vinyl-covered foam wing panels and tail feathers, a fuel tank, a motor mount, a spinner, wheels, vacuum-formed windows and windshield, decals, plans and a very complete hardware package. There are also a number of ABS parts, including the cowl, wingtips, stab tips, rudder fairing, servo boxes, instrument panel, antenna, taillight and seats. Instructions are provided in several languages right on the plan and include a complete list of every part identified by number, name, material, size (in millimeters) and quantity. Although the plan is not full-size, it does show every part by its identification number; I found this very helpful. In addition, the parts are numbered consecutively in the order in which they are used—also very helpful.

CONSTRUCTION

The first thing I did before starting construction was identify and number all the laser-cut parts while they were still in the plywood sheets. I also numbered all the other wooden parts, including the stripwood.

• **Fuselage.** I started construction with the fuselage, which is the part of the Arrow that requires the most effort. It is basically a plywood frame with the nose section, the cabin and the upper surface planked with balsa stripwood. All of the plywood parts are laser-cut and interlock to fit perfectly. This made it rather easy to keep things in proper alignment. Very small nails are provided to attach the plywood parts, but I chose not to use them, as I was



The vinyl-covered foam tail-pieces arrive as shown here. Simply separate the rudder and elevator from the fin and stab, and apply balsa to the exposed edges in preparation for hinging.

SPECIFICATIONS

MODEL: Piper Arrow 2

MANUFACTURER: Aviomodelli

DISTRIBUTOR: Internet-RC

TYPE: sport-scale kit

WINGSPAN: 83 in.

WING AREA: 1,160 sq. in.

WEIGHT: 13 lb., 15 oz.

WING LOADING: 27.7 oz./sq. ft.

LENGTH: 60 in.

ENGINE REQ'D: .61 to .91 2-stroke or .91 to 1.20 4-stroke

ENGINE USED: O.S. .91 FX 2-stroke

RADIO REQ'D: 5-channel w/6 servos (elevator, rudder, throttle, flaps, 2 aileron)

RADIO USED: Futaba 7-channel transmitter and receiver w/5 FMA 301 servos and 1 FMA 355 servo (elevator)

PROPELLER USED: APC 15x8

FUEL USED: Wildcat 15%

PRICE: $249.99

FEATURES: laser-cut balsa and ply fuselage pieces; vinyl-covered, foam-core wings and tail feathers; kit includes a fuel tank, engine mount, spinner, wheels, vacuum-formed windows and windshield, decals, plans, a very complete hardware package and a number of ABS parts, including the cowl, wingtips, stab tips, rudder fairing, servo boxes, instrument panel, antenna, taillight and seats.

COMMENTS: the Aviomodelli Piper Arrow 2 is an attractive, well-made airplane intended for intermediate builders and fliers. It offers enough of a challenge to satisfy most kit builders but also provides sheeted foam-core wings and tail feathers to reduce building time.

HITS

- Excellent laser-cut parts fit.
- Good parts identification.
- Stable, scale-like flight performance.

MISSES

- Construction plans not full-size.

FLIGHT PERFORMANCE

The instructions don't specify the proper throws for the control surfaces, so you're pretty much on your own here. For the initial flights, I set the throws as follows: ½ inch for ailerons, ⅝ inch for elevator and 1 inch for rudder.

TAKEOFF AND LANDING

After performing a routine preflight check and making sure that all the control surfaces were moving in the right direction, I fired up the O.S. .91 engine and taxied out to the center of the runway. Thanks to the steerable nose gear and widely spaced main gear, the Arrow handles well on the ground, with no tendency to tip. After getting the feel for how the Arrow handled on the ground, I pointed the nose into the wind and slowly advanced the throttle. The Arrow tracks straight ahead without rudder input and quickly accelerates to flying speed.

When flying speed is reached, I apply slight up-elevator; the plane rotates and starts a very realistic, scale-like climb. After it makes the first turn and levels off, the Piper Arrow requires no trim adjustments to maintain straight and level flight.

Landings are also scale-like; the Arrow stays as steady as a rock at low speed. I lower the flaps on the base leg and turn onto approach at ½ throttle. Once lined up on approach, I use the elevator to slow things down and the throttle to control the altitude. As the plane crosses the threshold of the runway, I chop the engine to idle and just let the Arrow descend until it's about a foot off the runway. I then apply enough up-elevator to get the plane to flare so that the main wheels touch down just before the nosewheel. With the controls at neutral, the Arrow continues its rollout until I steer it slowly back to the pit area for another enjoyable flight.

LOW-SPEED PERFORMANCE

The Arrow flies smoothly and predictably at slow speed. To test the stall, I took the Arrow to a safe altitude and reduced the power while adding more and more up-elevator until it eventually stalled. When it does stall, it's gentle and straight ahead. In fact, the plane

begins to porpoise as it flies through stall after a stall and each time nearly comes to a standstill. When you see a plane with such gentle stall characteristics, you know it's going to be easy to land.

HIGH-SPEED PERFORMANCE

This is a bit misleading; the Arrow doesn't really attain "high" speed even at full throttle. Rather, it moves along at what I would call a brisk, scale-like speed. I didn't experience any bad tendencies at full throttle. The Arrow tracks very well and pretty much goes where you point it.

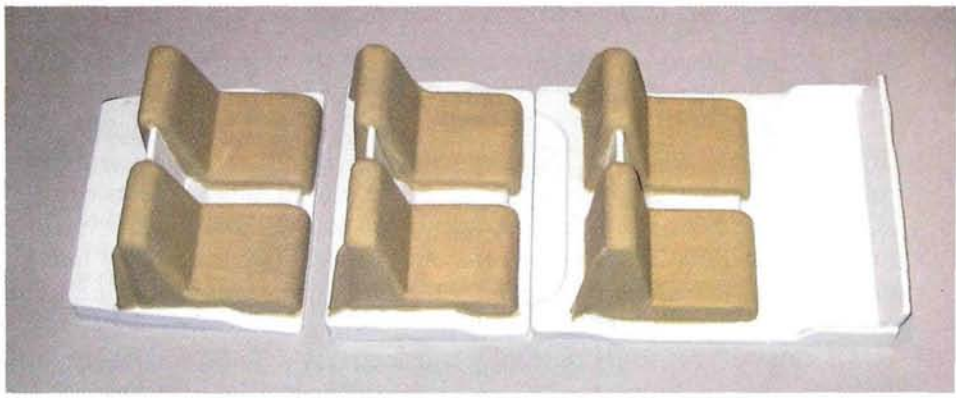
AEROBATICS

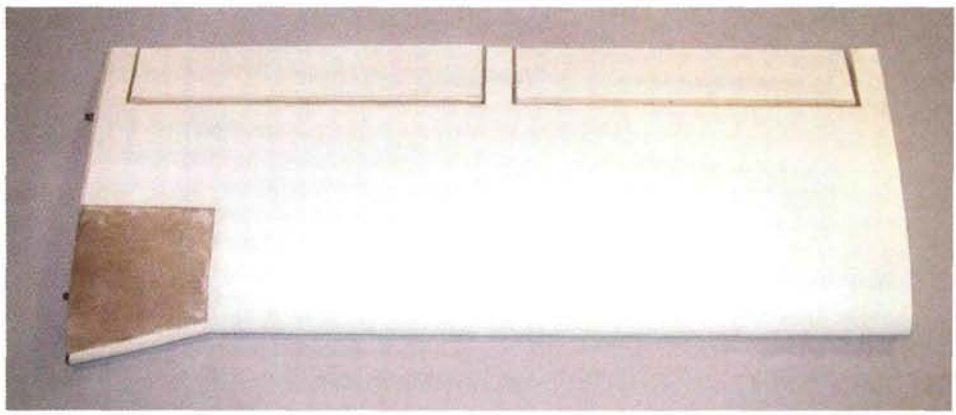
I doubt that anyone would build a Piper Arrow for its aerobatic capabilities. After all, it's a scale model and is most at home flying like one. However, having said that, I must admit that I wanted to see what it could do and had a lot of fun trying some mild maneuvers. I found that the Arrow is capable of loops, axial rolls (with coordinated rudder and elevator input), stall turns and inverted flight, but I couldn't get it to snap or spin (most likely because it's so hard to stall!). With a little more weight in the tail, it may be possible to coax the Arrow into a spin, but why mess with a good thing?

afraid they would split the plywood. I used 5-minute epoxy on the plywood parts and aliphatic glue, which is easy to sand, for the planking. A large hatch on the bottom of the fuselage provides access to the radio equipment, which, when installed, is completely hidden under the seats.

• **Tail feathers.** The tail feathers came next. Since these are vinyl-covered foam-cores, all that was required here was to separate the elevator and rudder from the stab and fin and to apply balsa to the exposed leading and trailing edges and thin plywood to the ends. The ABS stab tips were attached with medium CA. I inserted the wing tube into the fuselage to make sure that the stab was aligned properly, then I glued the stab and fin to the fuselage with 30-minute epoxy. I didn't hinge the rudder and elevator until after the plane had been covered.

• **Wings.** The Arrow uses plug-in wing panels, and I completed those next. I numbered the flaps and ailerons before I cut them from the wing panels so they wouldn't get mixed up. Then, I covered all the exposed edges with balsa and plywood





Above: the included ABS plastic seats are a nice touch. They really contribute to the Arrow's scale appeal. Below: like the tailpieces, the plug-in wing panels are vinyl-covered foam-cores.

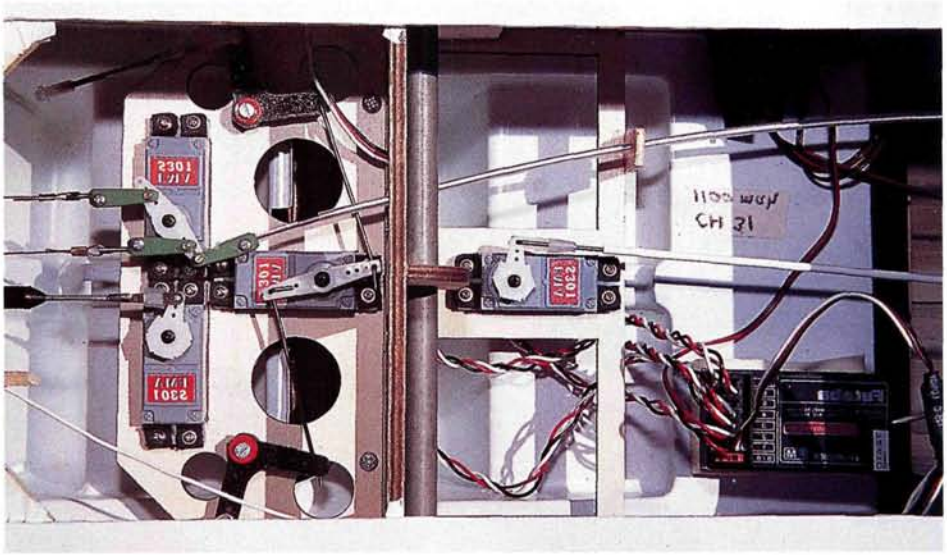
as I had done with the tail feathers. Pinned hinges are used for the ailerons, but the flaps use torque rods that are connected to a servo in the fuselage. These were not attached until after the plane had been covered. Two ABS servo boxes provided for the aileron servos were cemented into the cutouts in the wing panels, and the servos were attached to the box covers. I thought this was a very clever way of installing servos in a foam-core wing. The wing stiffeners, into which the metal wing tube fits, were made by laminating five laser-cut plywood parts and then gluing them into the wing with 30-minute epoxy. The stiffeners also hold the main landing gear that I attached after the plane had been covered. I attached the ABS wingtips with medium CA and epoxied the root ribs and the anti-rotation pins to the root ends of the wing panels. Once the wings have been slid onto the metal wing tube, they are held in place by two spring retainers attached to hook eyes in the wing. These were screwed into dowels that were then epoxied into the root ends of the wing panels. The final step was adding the tapered sections to the leading edges of the panels.

The finished product looks great in the air and on the ground.

• **Details.** Next, I painted the inside of the cabin with flat-black acrylic paint and glued in the vacuum-formed windows from the inside. The ABS seats come in three sections. I painted the seats tan and the floor black and then installed the seats in the fuselage. This was a little tricky because the seats fit very snugly, and the only access is through the bottom hatch. I didn't install a pilot figure but made the windshield removable in case I decided to add one later.

I painted the cowl with white LustreKote and covered the entire model with white Ultracote; then I applied the self-stick decals provided in the kit. I had to fit the large decal for the upper part of the fuselage around slight compound bends, so it was necessary to cut a few slits at the top of the decal to make it fit properly.

• **Engine installation.** The firewall is pre-drilled for the engine mount, nosewheel brackets and fuel-tank stopper. The tank is mounted on the right side of the fuselage; this places it right behind the engine cylinder. I think it would have been better if it had been mounted on the left side so the fuel lines could be routed more easily. The two-piece, adjustable engine mount is made of a composite material with a steel bolt embedded in it. The bolt goes through the firewall and is secured with a nut. I side-mounted an O.S .91 FX 2-stroke engine with a Pitts-style Slimline muffler on the mount, and after making the necessary cutouts, I attached the cowl with four screws. I used a 15x8 2-blade APC prop with a Tru-Turn aluminum spinner.



Above: two trays built inside the fuselage hold all the radio equipment; one tray holds the rudder, elevator and flap servos, and the other holds the throttle servo. Left: the Slimline muffler exhaust stacks neatly exit around the nose gear. This creates a nice, scale look.

• **Radio installation.** Last, I attached the control surfaces and installed the radio equipment. Four servos were mounted on two trays inside the fuselage. One tray holds the rudder, elevator and flap servos, and the other holds the throttle servo. I used an FMA 355 servo for the elevator and FMA 301 servos for the rest of the controls. The rudder uses a pull-pull cable system, and the elevator uses a solid pushrod. The flaps are controlled by a single servo that operates two bellcranks with linkages to the flap-control horns that extend into the fuselage when the wing panels are attached. To compensate for misalignment, I used ball links rather than clevises to attach the linkages to the flap control horns.

CONCLUSION

I enjoyed building and flying the Piper Arrow 2 and gladly recommend it for intermediate builders and fliers. The kit has several unique features that make it interesting to build. The finished product looks great in the air and on the ground. This is one you can be proud of.

APC Props; *distributed by Landing Products (530) 661-0399; apcprop.com.*

Aviomodelli; *distributed by Internet-RC Radio Control (602) 320-7114; internet-rc.com.*

FMA Direct *(800) 343-2934; (301) 668-4280; fmadirect.com.*

Futaba; *distributed by Great Planes Model Distributors; futaba-rc.com.*

Great Planes Model Distributors *(217) 398-6300; (800) 682-8948; greatplanes.com.*

LustreKote; *distributed by Great Planes Model Distributors.*

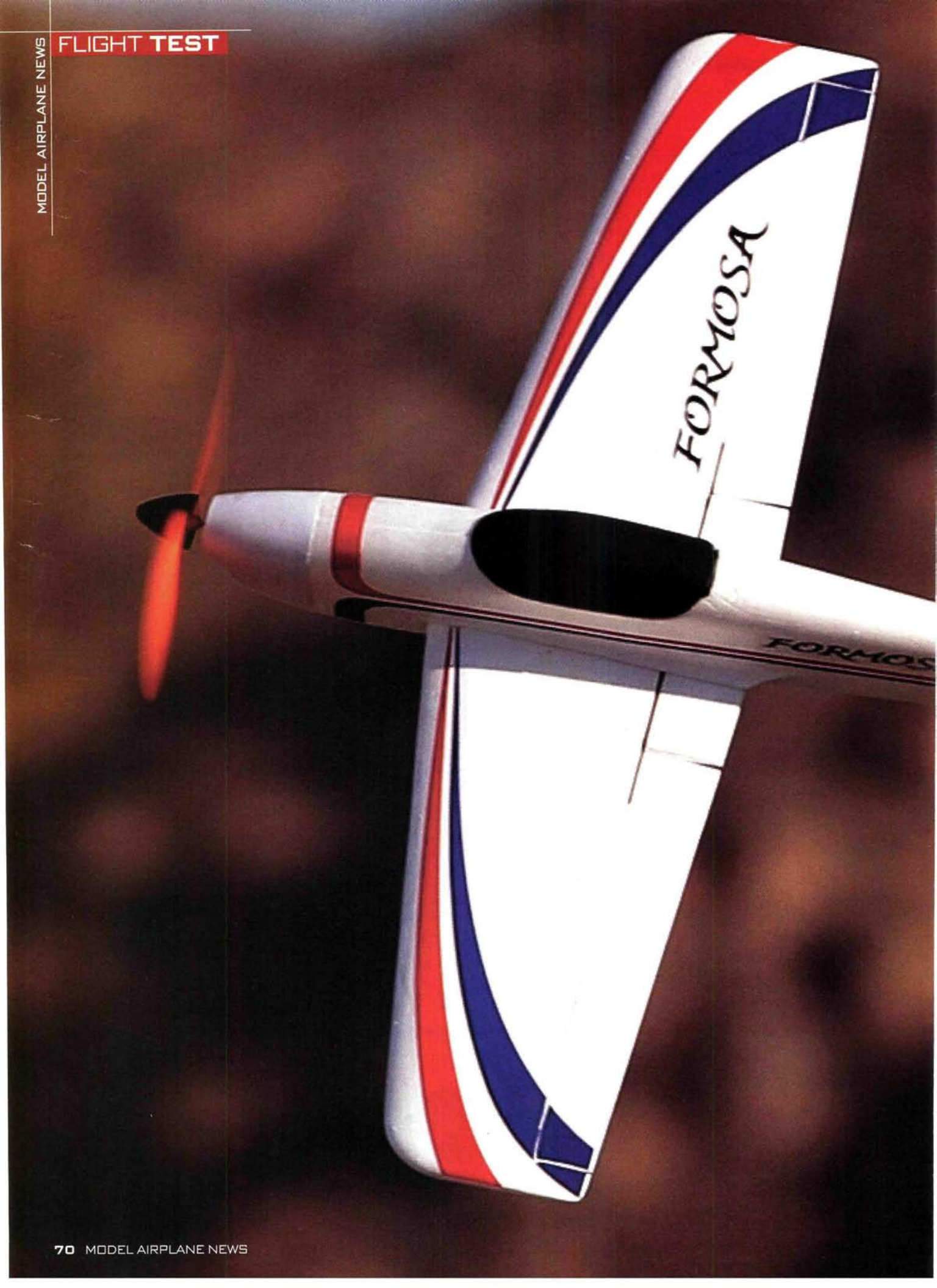
O.S.; *distributed by Great Planes Model Distributors; osengines.com.*

Slimline Mfg. *(480) 967-5053; slimlineproducts.com.*

Tru-Turn Precision Model Products; *distributed by Romco Mfg. (713) 943-1867; tru-turn.com.*

Ultracote; *distributed by Horizon Hobby Inc. (800) 338-4639; horizonhobby.com.*

Wildcat Fuels *(859) 885-5619; orders only (888) 815-7575; wildcatfuel.com.*


FORMOSA
FORMOS

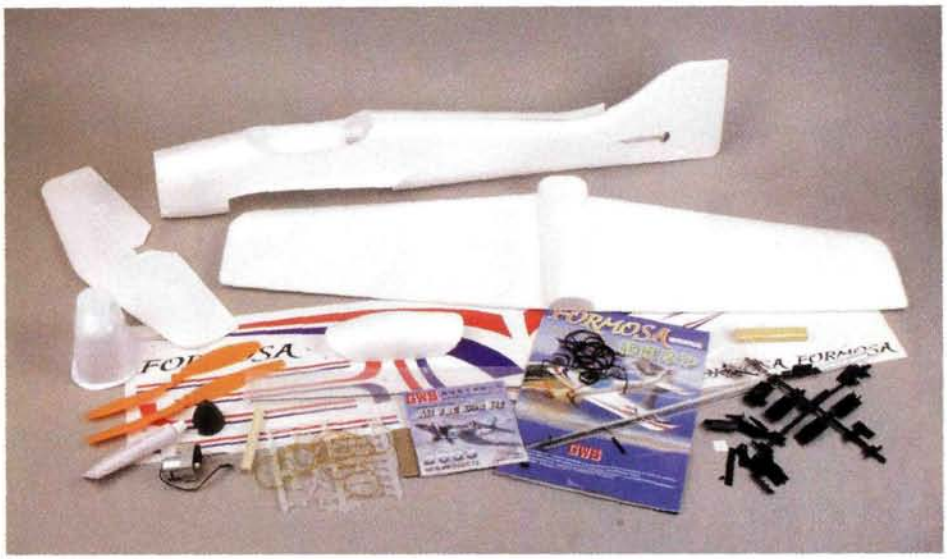
GWS Formosa

Pint-size pattern park flyer

by David Harris

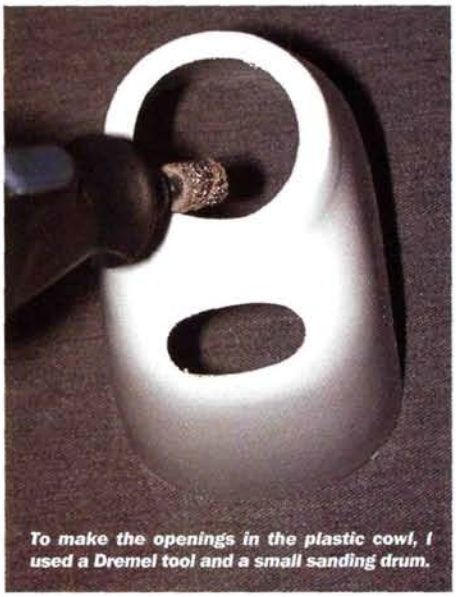
Jan Huygen Linschoten, an early 17th-century Dutch navigator, passed by the island that today is known as Taiwan and exclaimed, "Ilha formosa!" (beautiful island). It is therefore fitting that GWS (which is based in Taiwan) would call its latest park flyer the "Formosa." This sharp-looking model takes to the name well, as it's not only pleasing to the eye but also pleasing to fly.

PHOTOS BY DAVID HARRIS & JOHN REID



IN THE BOX

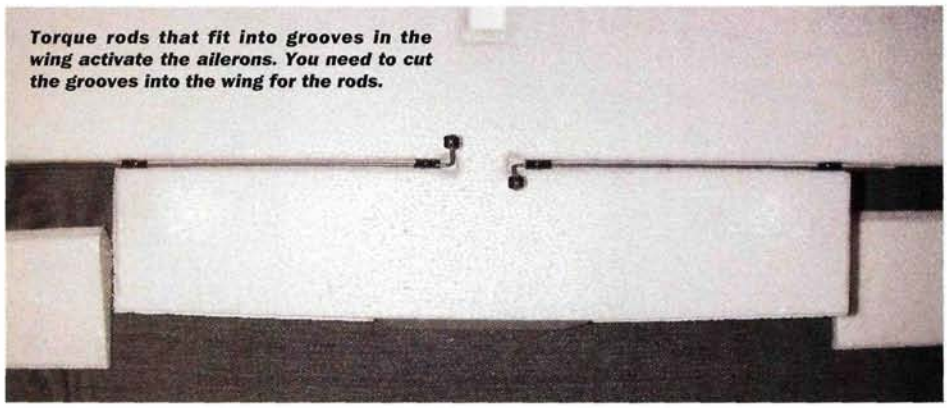
The Formosa has relatively few parts and comes with a step-by-step photo-illustrated instruction booklet. The foam fuselage is molded in halves and includes the vertical fin/rudder. The flying surfaces are one-piece foam moldings from which you must cut the control surfaces. The power system supplied with the Formosa is the GWS 350-C that's geared 5.33:1, and the kit includes a choice of props. It also contains a safety spinner, landing gear, control rods, hardware and a set of decals. To get the Formosa airborne, you'll need to supply a 4-channel radio, a 15A electronic speed control (ESC) with battery-eliminator circuit (BEC), three microservos and a 7- or 8-cell NiMH battery and charger. Every time I build a GWS plane, I get this feeling of déjà vu; they all use the same proven format and build sequence, which is straightforward and easy. Let's get started!



To make the openings in the plastic cowl, I used a Dremel tool and a small sanding drum.

CONSTRUCTION NOTES

• **Fuselage.** Construction starts by installing the pushrod tubes in the fuselage. The tubes need to be 370mm long. I don't have a metric ruler; I use a simple formula to convert millimeters to inches: I multiplied 370mm times 0.03937, which equals 14.56 inches. I then round the answer to the nearest whole number. After I had installed the pushrods, I glued the fuselage halves together with 5-minute epoxy and held them together with rubber bands while the glue dried. The Formosa sports a removable canopy hatch that's attached with a magnet, and this allows easy access to the radio components and battery.



Torque rods that fit into grooves in the wing activate the ailerons. You need to cut the grooves into the wing for the rods.

SPECIFICATIONS

MODEL: Formosa

TYPE: electric pattern park flyer

MANUFACTURER: Grand Wing Servo (GWS)

DISTRIBUTOR: Horizon Hobby Inc.

WINGSPAN: 35.4 in.

WING AREA: 255.8 sq. in.

LENGTH: 35.9 in.

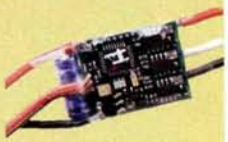
READY-TO-FLY WEIGHT: 18.2 oz.

WING LOADING: 10.24 oz./sq. ft.

DRIVE SYSTEM SUPPLIED: GWS EPS-350C geared 5.33:1

BATTERY USED: Kan 8-cell, 950mAh NiMH w/Castle Creations Pixie 20 ESC

RADIO REQ'D: 4-channel (aileron, elevator, rudder, throttle)



RADIO USED: Hitec Eclipse 7 transmitter w/Electron 6 receiver and 3 Cirrus CS6.3 servos

FLIGHT DURATION: 8 min.

PRICE: $45.99

FEATURES: foam construction; one-piece wing; assembled motor and gearbox; formed wire landing gear; safety spinner; propellers; formed plastic cowl; colorful decals; all necessary hardware; photo-illustrated instructions.

COMMENTS: this is an easy-to-assemble, fun-to-fly pattern-type park flyer with lots of power. Its large, aggressive flying surfaces make the model maneuver quickly, and with its high power-to-weight ratio, the model easily attains high speeds for exciting flights.

HITS

- Power system matched to airframe.
- Easy to build.
- Good aerobatic performance.
- Battery compartment accepts large-capacity batteries.

MISSES

- No provision for battery cooling.

FLIGHT PERFORMANCE

GWS states on the box that the Formosa is for advanced pilots; it flies very much like a high-performance pattern ship. I recommend a large flying area such as a soccer field; the Formosa can cover a lot of ground very quickly. In 5 to 10mph winds, the Formosa really shines. The wind has very little effect on it.

TAKEOFF AND LANDING

On a fully charged battery, the Formosa takes off from a hard surface quickly and has a better than average climb rate. If you fly from a grass field, the Formosa is easily hand-launched. The plane climbs steadily at about a 45-degree angle with the 8-cell, 9.6V battery and a GWS 10x4.7 prop.

Landing the model is best accomplished into any wind. The large vertical fin and plentiful fuselage side area combined with the model's light weight can make crosswind landings a little tricky. Once you become accustomed to its handling, you can very precisely land the Formosa in any area you choose.

LOW-SPEED PERFORMANCE

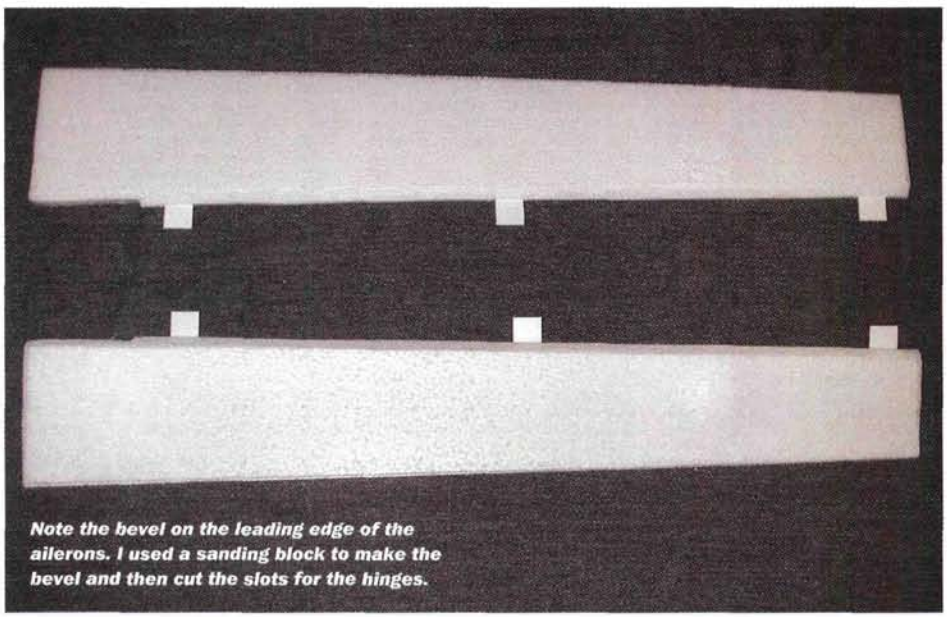
With its sleek and low-drag design, slow speed is a relative thing. Though the Formosa handles well at lower speeds, thanks to it large control surfaces, it really likes to fly flat out at full speed.

HIGH-SPEED PERFORMANCE

The Formosa's raw power and speed set it apart from most park flyers; this is because of its EPS-350C geared power system that produces 14.7 ounces of thrust. I estimate it flies at approximately 40mph in calm air. During your initial flights, allow lots of time to get used to the aggressive maneuvering this plane is capable of; it's very responsive to control inputs. If you are using a computer radio (recommended), use plenty of exponential for the ailerons and elevator; this will make the plane more docile.

AEROBATICS

The Formosa is a high-speed aerobatic performer capable of many pattern-style maneuvers such as loops, rolls, stall turns and spins. Inverted flight is effortless with only minimal down-elevator needed to maintain level flight. On a freshly charged battery, the Formosa can perform knife-edge flight the length of your flying area with little effort. There is some rudder coupling, so be prepared to use aileron input to counter it. In the hands of an experienced pilot, the Formosa is a very capable plane, and it's quite a crowd-pleaser.



Note the bevel on the leading edge of the ailerons. I used a sanding block to make the bevel and then cut the slots for the hinges.

The motor/gearbox assembly simply slides onto a stick that's glued into the fuselage. Simple and easy.

Next, the motor and gearbox are mounted to a hardwood stick that's glued into a matching molded recess in the nose of the fuselage. I noted that the motor assembly was easily slid fore and aft, so I waited until I completed the model to mount the assembly; this would make it very easy to achieve the proper center of gravity without having to add weight. I now fitted the cowl, and the directions recommend using a pair of scissors to trim it to size. Instead, I used a Dremel rotary tool with good results.

• **Wing.** For strength, the one-piece foam wing uses a bamboo stick as a spar that's glued into a molded slot, and it's covered with a white decal to conceal it. Using a sharp hobby knife, I cut the ailerons free from the wing and beveled their leading edges. I used a sanding block to make the bevel. I then cut a groove in the wing for the aileron torque rods; they must be installed before hinging the ailerons to the wing. I cut three equally spaced 10mm slots in each aileron and then glued all of the aileron hinges in the ailerons using the kit-supplied foam-safe glue. I used a pencil to mark the wing where the mating hinge slots needed to be cut. I then made the cutouts and glued the ailerons and torque rods into place. The landing-gear wires are screwed to plastic mounts that are glued on the bottom of the wing. The

last step of the wing assembly is to install the wing hold-down support.

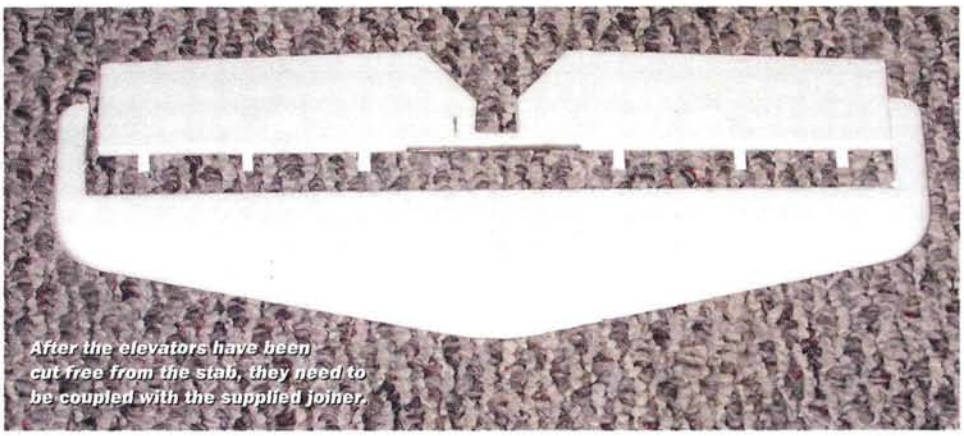
• **Tail surfaces.** Like the ailerons, the elevators and rudder need to be cut free, beveled and hinged, so I decided to do them together. I hinged the rudder making sure that I didn't install a hinge in the elevator cutout. The rudder hinges are glued into place after the stabilizer has been installed in the fuselage. Next, I removed the elevator from the stabilizer, beveled its leading edge, glued the prebent joiner wire into place and hinged the elevator to the stabilizer. I temporarily installed the wing so I could properly align the stabilizer as I glued it into place with 5-minute epoxy. I used a ruler to center the assembly and set the plane on a pair of level 2x4-inch wood blocks while the epoxy dried. I then glued the rudder into place and installed the control horns.

The GWS Formosa is a fun model to fly that has lots of power.

• **Radio and motor installation.** Radio installation is a snap. I simply pushed my Hitec Electron 6 receiver into the cavity at the rear of the canopy opening. To control the ailerons, elevator and rudder, I used three Cirrus CS6.3 servos. They fit neatly into the fuselage, and I glued them into place. To get the power from the 8-cell, 950mAh NiMH Kan battery, I used a Castle Creations Pixie 20 ESC. It's rated to 20 amps continuous and features a BEC and a brake. The battery fit neatly in the molded battery cavity, and the removable canopy hatch makes installing and removing the battery a simple task. One thing I did notice, though: there's no provision for cooling air to flow over the battery during flying sessions. Be sure to monitor your battery so it doesn't overheat.

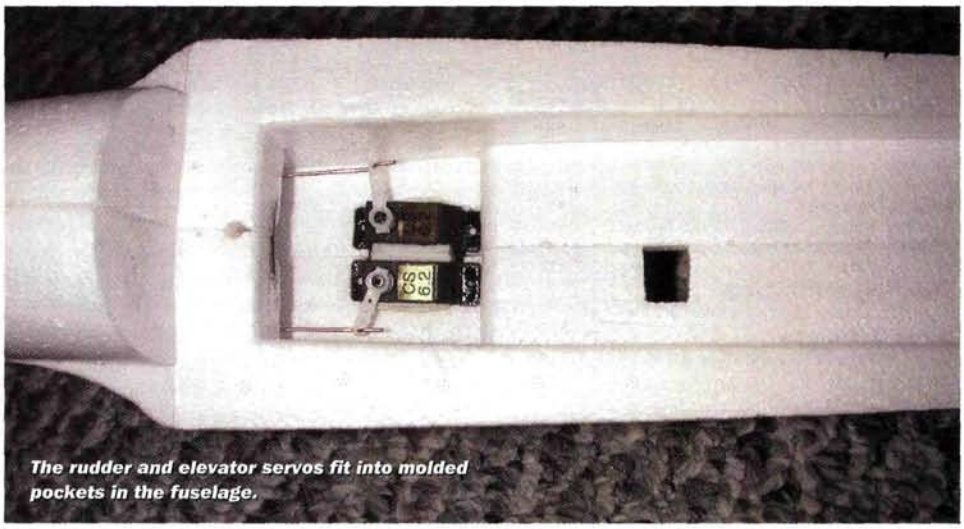
• **Final assembly.** As I stated earlier, I waited to install the motor so I could use it to balance the model without adding unnecessary weight. As it turns out, this was not necessary; I had plenty of room to place the battery where needed to balance the plane without adding additional weight.

There is very little work needed to finish the Formosa. The decals are precut and are easily applied. Remember, the canopy is foam, and if you choose to paint it as I did, use a foam-safe paint. I painted the canopy with Tamiya water-based paint that I applied with an airbrush.



After the elevators have been cut free from the stab, they need to be coupled with the supplied joiner.

Access to the battery is through the removable canopy; two pins at the front and a magnet at the rear keep the canopy in place during flight.



The rudder and elevator servos fit into molded pockets in the fuselage.

CONCLUSION

The GWS Formosa is a fun model to fly and has lots of power. My building experience was very enjoyable, and I didn't encounter any problems. The kit is very complete and takes only a few evenings to build. I wouldn't hesitate to recommend the Formosa to any accomplished pilot who wants an inexpensive performer.

Castle Creations *(785) 883-4519; castlecreations.com.*

Cirrus; *distributed by Global Hobby Distributors (800) 854-8471; (714) 963-0133; globalhobby.com.*

GWS; *distributed by Horizon Hobby Inc. (800) 338-4639; horizonhobby.com.*

Hitec RCD Inc. *(858) 748-6948; hitecrcd.com.*

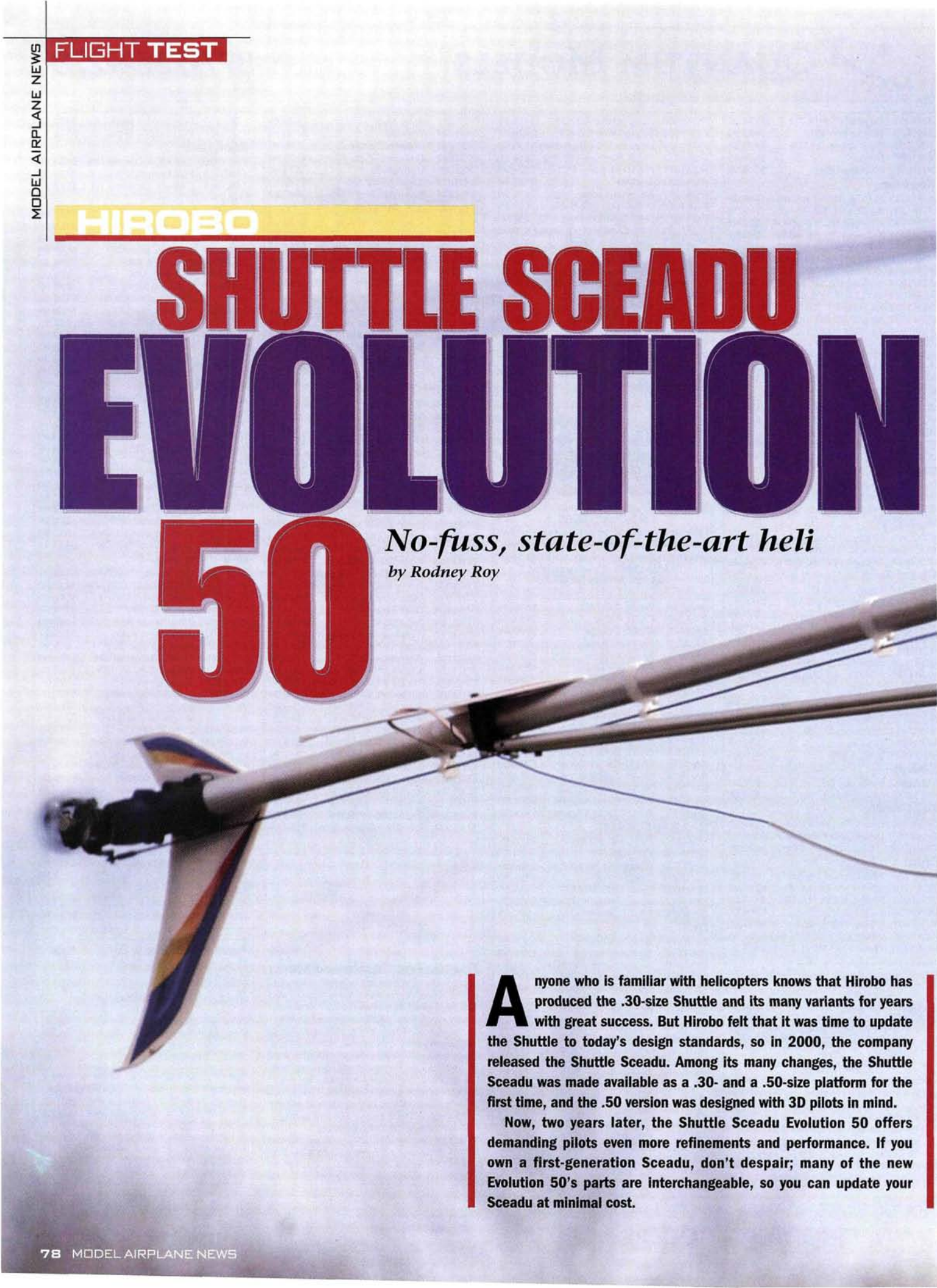
Tamiya America Inc. *(800) 826-4922; tamiyausa.com.*

HIROBO

SHUTTLE SCEADU EVOLUTION 50

No-fuss, state-of-the-art heli

by Rodney Roy



Anyone who is familiar with helicopters knows that Hirobo has produced the .30-size Shuttle and its many variants for years with great success. But Hirobo felt that it was time to update the Shuttle to today's design standards, so in 2000, the company released the Shuttle Sceadu. Among its many changes, the Shuttle Sceadu was made available as a .30- and a .50-size platform for the first time, and the .50 version was designed with 3D pilots in mind.

Now, two years later, the Shuttle Sceadu Evolution 50 offers demanding pilots even more refinements and performance. If you own a first-generation Sceadu, don't despair; many of the new Evolution 50's parts are interchangeable, so you can update your Sceadu at minimal cost.

SO, WHAT'S NEW?

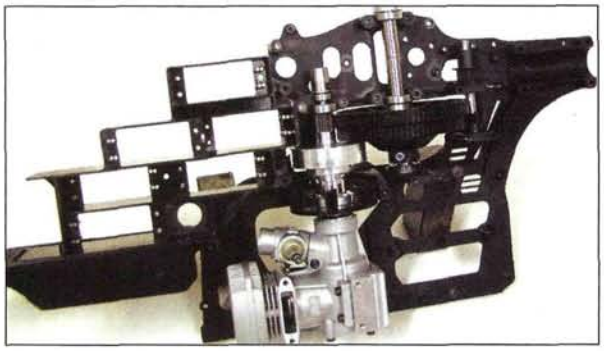
To start with, the frames have been molded of a tougher material that adds strength and makes them more rigid. A new, third main-shaft bearing that's below the main gear further stiffens the frames and supports the main shaft better for precise gear mesh during hard aerobatics.

The redesigned fuel tank holds more fuel, and it's secured between the frames by four rubber feet that isolate it from vibration. Demanding aerobatics make the engine work harder and generate more heat; to keep the engine happy, the cooling fan has been improved to increase the airflow over the engine's head. This was a weak spot on the first version of the Sceadu.

The main rotor head is the FZ-IV, which features a machined-aluminum center block and has the flexibility to be configured to meet any pilot's proficiency level. For example, the Evolution's head features an "autostability" configuration that makes it a stable trainer. Moving a few control balls and changing their pick-up points make the heli a potent aerobatic performer. Some other highlights of the Evolution are push-pull linkages, two-piece flybar paddles with adjustable weights and a longer-than-normal tail boom, so you can use 600mm-long main blades.

KIT CONTENTS

The Sceadu is a true builders' kit; none of the assemblies are factory built. All parts are bagged according to assembly steps and are numbered to correspond with the manual. The manual is full of very useful



Here's the Sceadu's transmission layout. Notice how the engine drives the upper gear, and the lower gear drives the tail-belt pulley. To preserve the gear mesh, the main shaft is supported by three hefty bearings.

information and contains more written instructions than Hirobo's past efforts have. This is a welcome change! The manual covers both the .30 and .50 versions of the Sceadu, so you must be careful to follow the appropriate instructions when they appear. The belt-driven tail rotor uses a new, thinner, more flexible belt for less resistance and incorporates a split-gear, constant tail-drive to turn the tail rotor during autorotations. The tail-rotor servo is mounted on the tail boom for very positive tail-rotor control. All pivot points on the Evolution use ball bearings instead of bushings. The sleek canopy is blow-molded and very durable, and the decals are of a new high-visibility color and design. The kit also includes a muffler. One downside, though, is that the Evolution 50 doesn't come with any main rotor blades, as Hirobo assumes that very few pilots would use kit-supplied wood blades on a machine of this caliber.

ASSEMBLY NOTES

Before you start to assemble the Sceadu, read the manual and gather the tools that you'll need. You'll also need thread-lock (I used blue Loctite) for all metal-to-metal fasteners. The machining of the metal parts and the plastic moldings of the kit was outstanding; everything fit together very precisely!

Mainframe assembly. The frames are molded in halves that are screwed together. The servo tray, main shaft bearings, tail-rotor pick-up and elevator lever are sandwiched between the frames before they're mated. The one-piece servo tray has plenty of room for the radio components. Before you fully tighten the frame halves, slide the main shaft into the bearings to properly align them. Here's a tip: leave the landing gear assembly off the model until the engine has been installed. You'll need to spread the frames apart slightly to slide the engine and its mount into place.

Swashplate. The swashplate's composite construction is comprised of a plastic outer ring and a metal inner ring. You'll need to install the seven control balls in the rings. The longer balls are used on the inner ring, and I used a drop of thread-lock to make sure that they stayed put. Before I installed the outer balls, I used a 3mm cap-head bolt to thread the holes. Don't overtighten the balls, or you risk stripping the outer ring. I also placed a drop of thick CA on the threads before I screwed the control balls into place.

Main rotor head. The Evolution 50 comes with the FZ-IV rotor head and uses a conventional single axle design that's supported by twin rubber dampers. The blade grips are supported by two ball bearings and one thrust bearing. Before you build the head, you must choose which mixing options you're going to use. There are two positions for the Bell-Hiller mixing arms. The manual says the inside holes are for "high mobility," and the outer holes are for "autostability."

The heart of any helicopter is the main rotor head, and the Sceadu's is a work of art. You can easily adjust the position of the mixing arms to fine-tune the control response.

Beginners will want to use the outer holes to make the model feel less twitchy and have greater stability in the air. Be certain to grease the thrust bearings and install them correctly; the race with the larger inside hole is inserted first. The flybar paddles have weights that you can remove to fine-tune the model's control response. I recommend that you leave all of the weight intact. The rotor system has great control authority, and if you remove any of the paddle weight, the heli becomes very responsive. I was slightly surprised that the flybar is only 3mm in diameter because it might flex under high-load maneuvers. Given the aerobatic potential of the heli, I thought the flybar should have been beefed up to a 4mm diameter.

Tail rotor/tail boom. The tail rotor is easy to assemble, and each blade grips a ball bearing and a thrust bearing. Just as you did for the main rotor, grease the thrust bearings and install them correctly. Before snapping the case halves together, make sure that you capture the drive belt. I balanced

SPECIFICATIONS

MODEL: Shuttle Sceadu Evolution 50

MANUFACTURER: Hirobo

DISTRIBUTOR: MRC

TYPE: .50-size aerobatic helicopter

ROTOR DIAMETER: 53 in. (1,348mm)

LENGTH: 46¾ in. (1,190mm)

HEIGHT: 17¼ in. (435mm)

WEIGHT: 7 lb. 2 oz.

RADIO REQ'D: 5-channel heli radio

RADIO USED: JR 10X transmitter, 4 JR DS 8231 digital servos, 1 JR NES 4131 servo and 1 JR 450 gyro

ENGINE REQ'D: .50 2-stroke heli

ENGINE USED: O.S. 50SX-H

FUEL USED: Morgan 30% Nitro

PRICE: $399.99

FEATURES: FZ-IV rotor head that allows fine-tuning of control response; bearings on all pivot points; improved cooling fan; split gear for driven tail rotor during autorotations; thinner, low-drag tail belt; tougher main frames; easy-to-see decals; very good instructions.

COMMENTS: the Hirobo Sceadu Evolution 50 is the second-generation heli of the Sceadu series and is much improved. The heli is easy to build, thanks to the improved instructions and great-fitting parts. Flight performance is nothing short of outstanding! The rotor head provides excellent stability while maintaining the crisp control response that you need for aerobatics—not an easy combination to achieve. The Evolution 50 is well suited to beginners and experts alike.

HITS

- Easy assembly.
- Very good instructions.
- Full complement of bearings.
- Solid flight performance.

MISSES

- Thin (3mm) flybar.
- Main rotor blades not included.

FLIGHT PERFORMANCE

I installed a new O.S. 50SX-H in my Sceadu, and because it hadn't been broken in yet, I first hovered three tanks of fuel through it with it set very rich. After that, I leaned in the engine, and it ran very reliably. I also used Hirobo 600mm fiberglass blades; these blades have a symmetrical airfoil for outstanding aerobatic performance, and they proved to be a good match for the heli.

HOVERING

The first hovering flights were a little on the rough side, as the engine was breaking in, and the head speed was rather low. When the engine had been leaned in, the Evolution started to show its true colors. With a head speed of around 1,500rpm, the heli was nice and stable with good control response. After I had hovered the heli for a few tanks, it was very predictable with no vices.

FORWARD FLIGHT PERFORMANCE

The first Sceadu's rotor blades tended to go out of track during fast forward flight, so I was eager to see whether the updated FZ-IV head cured the problem. To check this out, I cranked the head speed up to around 1,800rpm and flew some circuits with very aggressive turns and sharp pull-ups and push-overs. The heli handled these maneuvers with no complaints, and the blades remained in track.

AEROBATICS & 3D

With the mild setup, the Sceadu Evolution 50 performed very well. Entries and exits from loops, rolls and stall turns were smooth and powerful. It felt as if the engine were being held back, and I decided to remove the baffle from the kit-supplied muffler. The next few flights confirmed my suspicions, as the engine now pulled a little harder. The downside, though, is that the engine/muffler is somewhat louder.

Remember the longer-than-normal tail boom? Well, it makes the heli track very well and feels larger than it actually is. On the upside, the tail holds very well in crosswind situations because of its increased leverage.

3D aerobatics such as flips, tumbles, sideways loops, backward loops and rolls aren't any problem for the Evolution 50, and I'm sure that more aggressive 3D maneuvers are well within its capabilities. With 600mm blades, the heli performs very nice autorotations, but you must carefully manage rotor speed because of the driven tail rotor. All in all, the Sceadu Evolution is a great-flying heli.

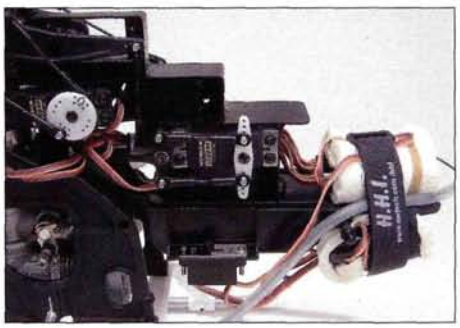
the tail rotor on a High-Point balancer before I installed it on the output shaft. This is a must for vibration-free operation! I installed the tail-rotor pushrod guides and the tail-rotor servo mount on the tail boom before I mounted it on the main frame assembly. Make certain the drive belt is twisted in the proper direction; if it isn't, the tail rotor will spin backward.

Engine assembly. Over the past several years, heli manufacturers have made engine installation much simpler, and installing the Evolution's engine is no exception. The cooling fan threads onto the engine's crankshaft, so it should run very true. Be sure to leave the engine-supplied spacer on the crankshaft for proper spacing. There are several ways to tighten the fan onto the crankshaft; some are good, and some are not so good. The recommended method is to remove the engine's backplate and jam the crank with a wooden dowel. Never use a piston-locking tool that screws in from the glow-plug hole; you risk denting the top of the piston, or worse, punching a hole in it. After I had installed the fan, I checked its runout with a dial indicator, and it was almost perfect. I fitted the clutch and starter shaft and checked their runout. I then fit the clutch-bell housing and slid the engine assembly into the main frames. Lining it up and setting the gear mesh went without a hitch.

The tail rotor is very robust; it uses a radial bearing and a thrust bearing in each tail-blade grip. This and the dual-point pivot make the tail-rotor response tight and positive.

Radio installation and setup. I installed the servos, the receiver, its battery and gyro as instructed by the manual. I then screwed the control balls onto the servo wheels and made the various pushrods. Take your time here, as the pairs of pushrods must be exactly the same length. The manual very clearly specifies the correct location of each pushrod and the direction in which each servo moves. Following the manual, I set up the 5-point collective pitch and throttle curves quite easily.

Final touches. All that was left to do was trim the canopy, apply the decals and mount the tail fins. I'm really glad to see that the Evolution's decals are multicolored for better visibility and orientation when the heli is in flight. The canopy uses vibration-absorbing, rubber grommets that slide over posts mounted on the frames; the canopy hardly shakes at all when the engine is running.



There's ample room up front for the receiver and its battery, so a tidy installation is a snap. The receiver switch is easy to access when the canopy is in place. Note the push-pull linkages on the collective and roll servos.

FINAL THOUGHTS

The Hirobo Sceadu Evolution 50 has evolved into a real class act; it's easy to build, and the rotor head provides excellent stability and control response. The model features bearings on all pivots points, constant tail drive, a push-pull control system, a decent muffler and very good instructions. It's nice to see a manufacturer such as Hirobo listen to modelers and incorporate their suggestions to improve a model. It's this type of attentiveness that makes Hirobo a leading manufacturer of RC helicopters!

***High Point**; distributed by Robart Mfg. (630) 584-7616; robart.com.*
***Hirobo**; distributed by MRC.*
***JR**; distributed by Horizon Hobby (800) 338-4639; horizonhobby.com.*
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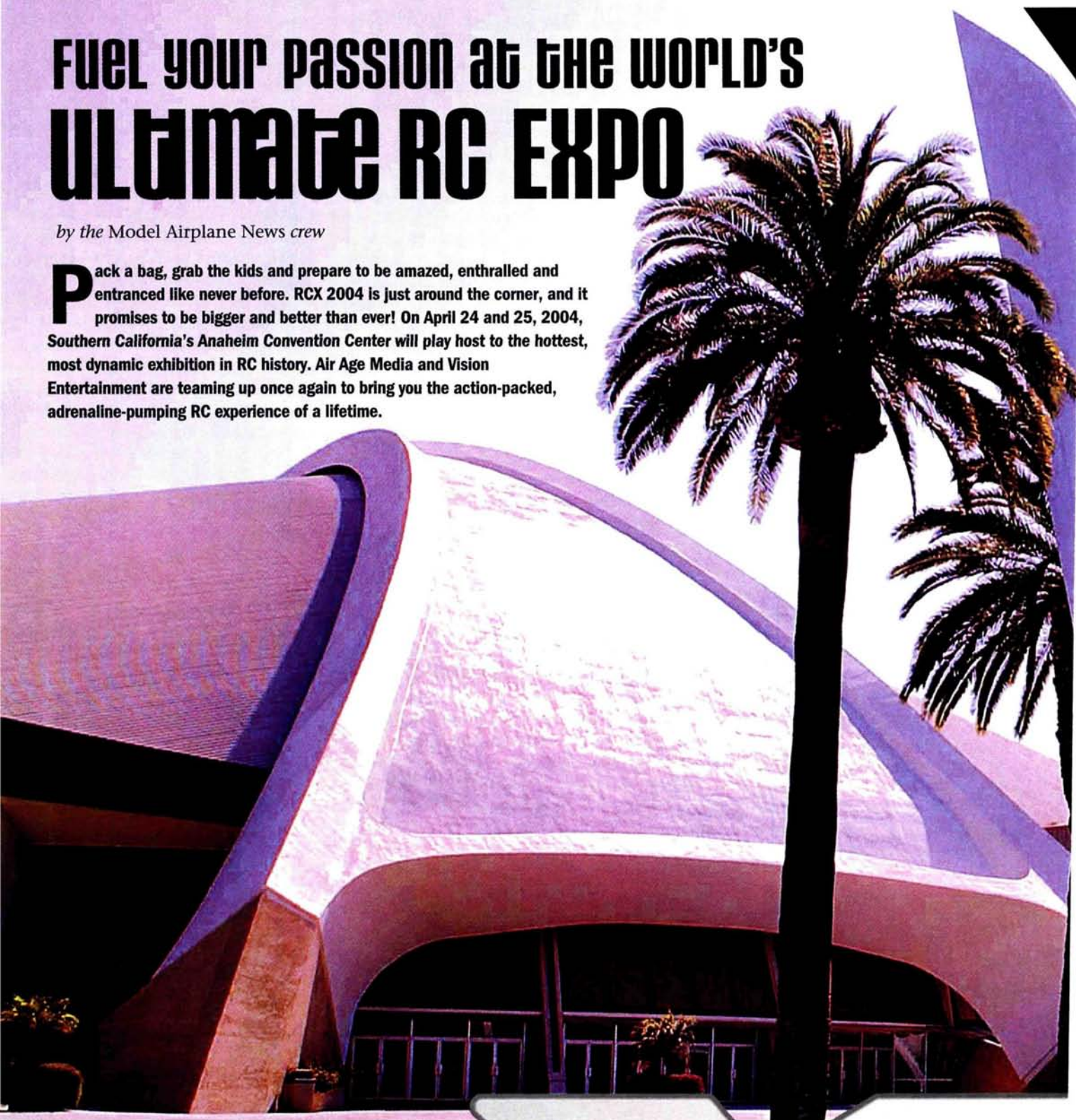

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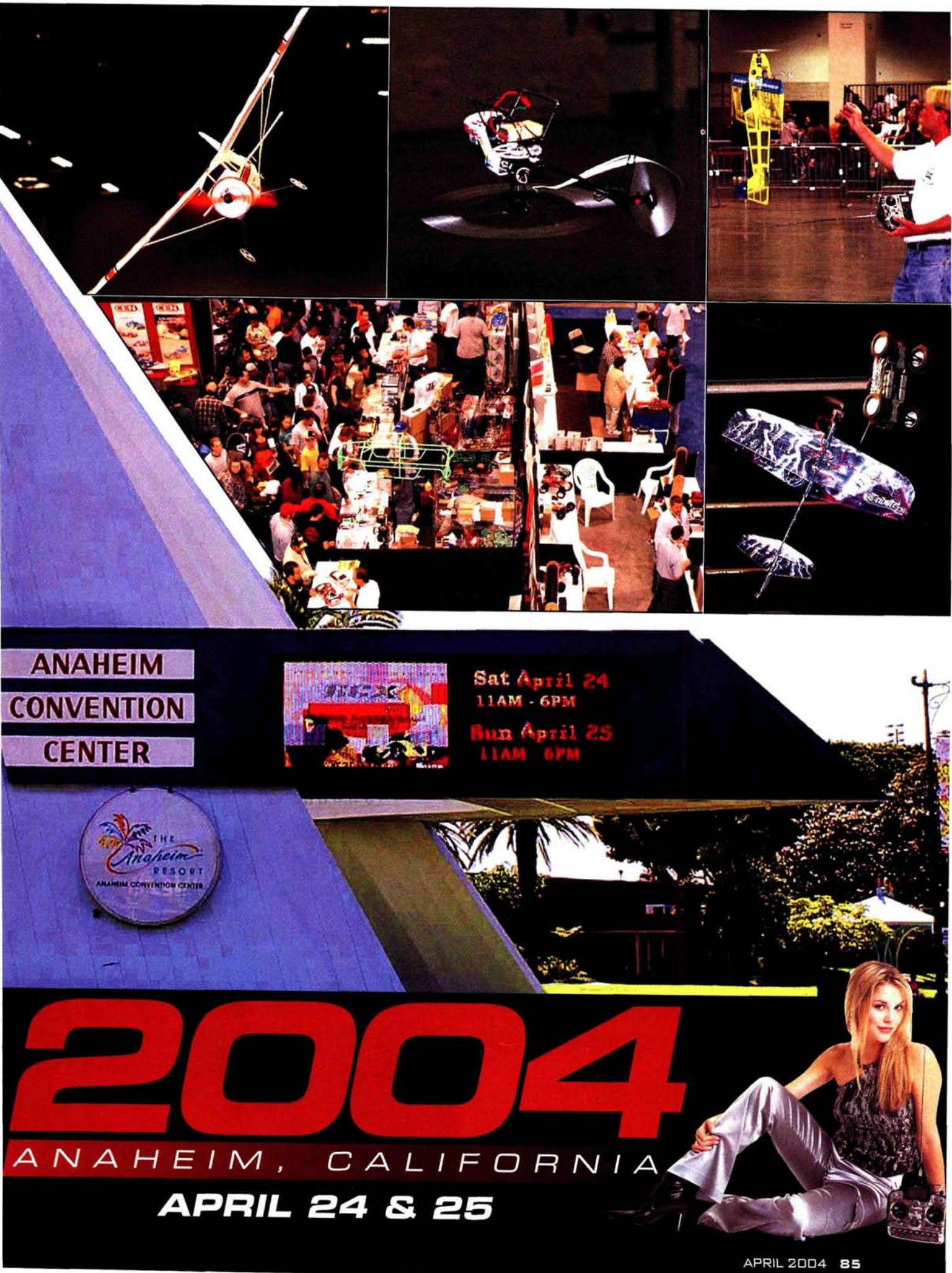
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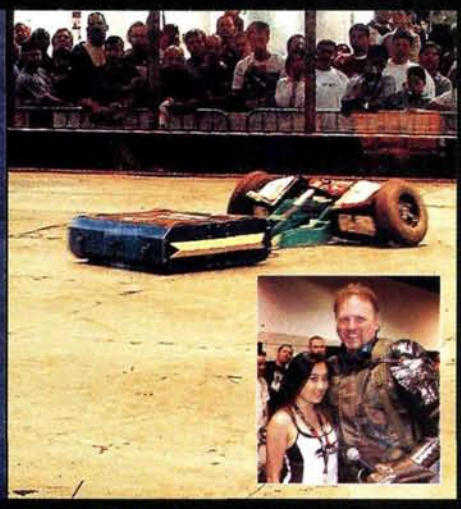

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To be able to fly under full control, all models must be balanced properly. To do this, we need to know where the correct CG location is.

Know your CG

Flight insurance for your model by Jerry Smith

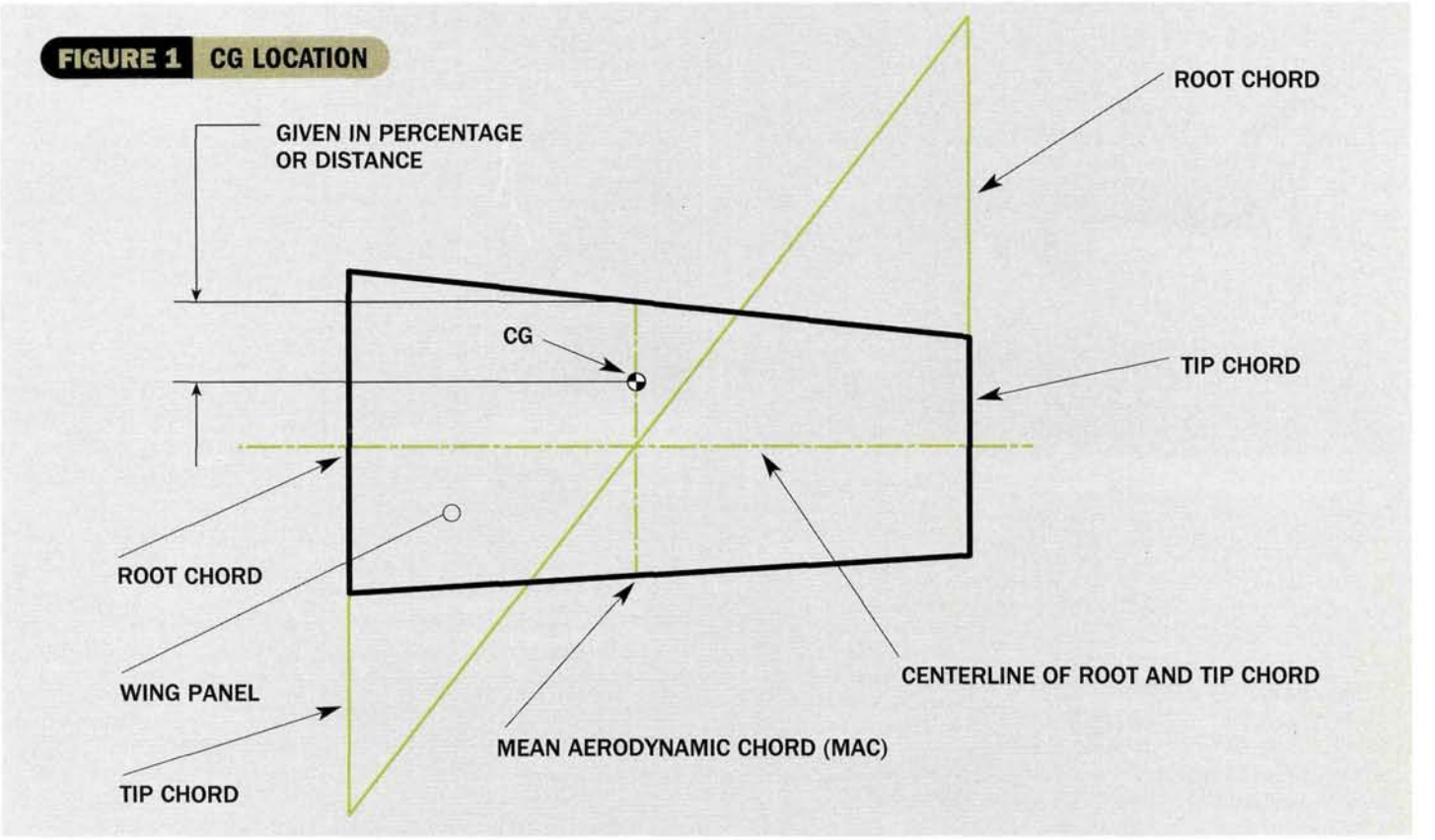
Many airplanes are damaged or destroyed on the first flight because the builder failed to check the model's center of gravity (CG) before he took it to the flying field. Some assume that if you assemble the model as directed by the instruction manual, a successful first flight is assured. Not always true! A little nose-heaviness is tolerable (in fact, it's sometimes desirable), but if the model is too tail-heavy, you will be busy with the sticks.

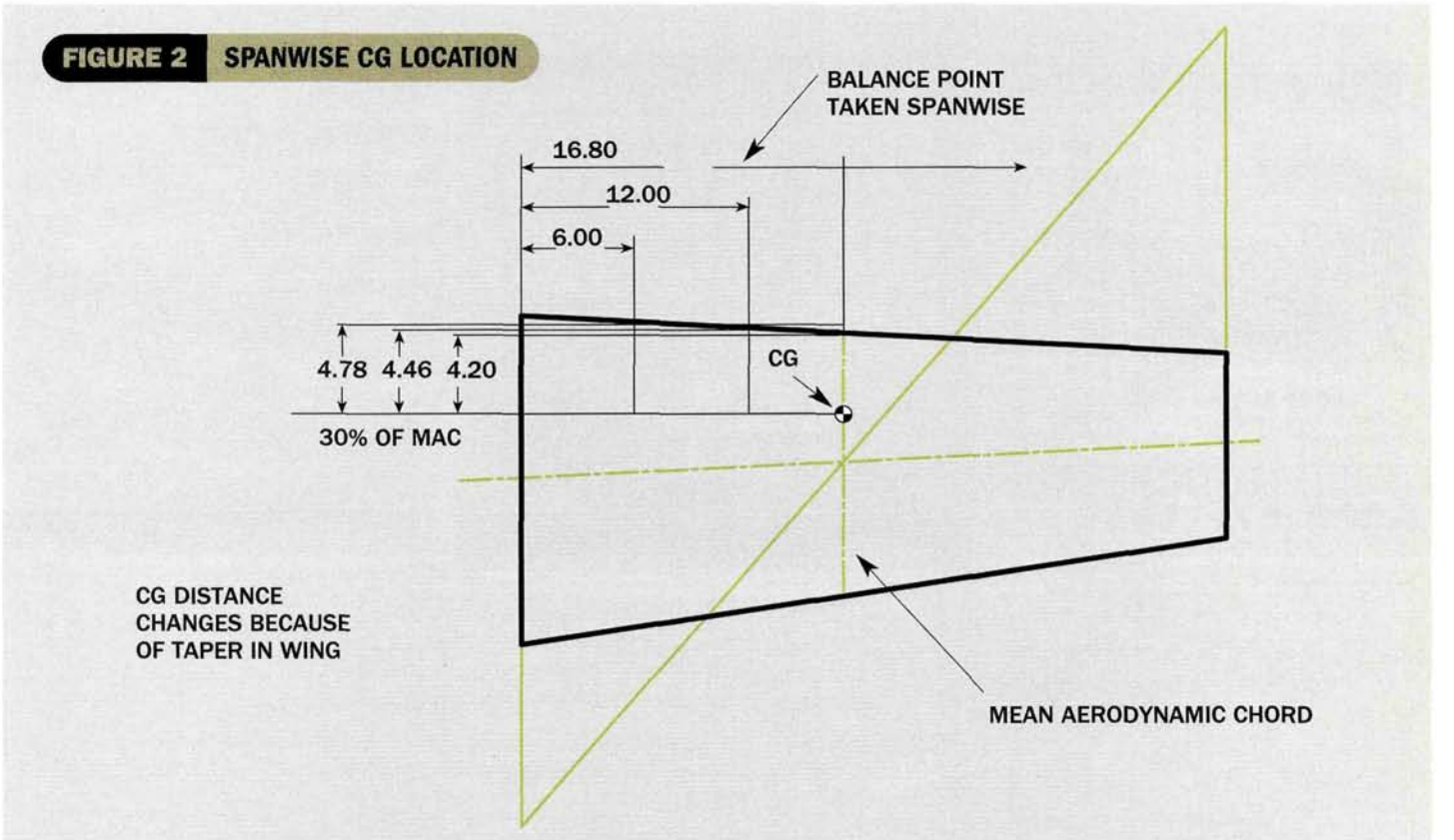
Most kits and plans indicate that the model's CG should be located at a specific point on the wing's mean aerodynamic chord (MAC). This point is usually identified as a percentage of the MAC, but it's sometimes given as a measurement. When you check your model's CG, pay attention to what it says in the manual, and then determine exactly where the CG should be. Generally, it should fall somewhere in the MAC's 25- to 30-percent range. Measure your wing's chord and mark the CG location. For example, on a 12-inch constant-chord wing, the 28-percent MAC is 3⅜ inches back from the leading edge (0.28 x 12 = 3⅜).

On a constant-chord wing, the MAC can be measured anywhere along the wing. With a tapered-wing plan, the MAC will fall somewhere in the middle of the wing panel (see Figure 1).

WHERE IS THE MEAN AERODYNAMIC CHORD LOCATED?

By measuring a tapered wing panel, the MAC can be graphically determined. You can use the model's full-size plans or draw your own layout. If you have a CAD program, you can also easily draw an accurate scale drawing. At the wing root, draw a reference line that extends aft from the trailing edge that's parallel to the fuselage centerline.



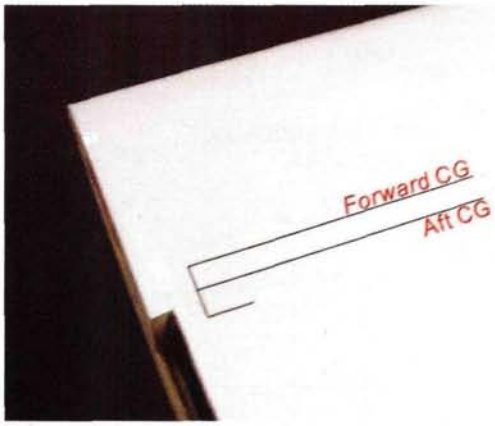


This line should be the same length as the tip chord. At the wingtip, draw another reference line forward of the tip that's the same length as the root chord. Now find the center of the root chord and tip chord, and connect the points with a centerline. Draw a diagonal line between the ends of the two extension reference lines at the tip and the root chord. The point at which the diagonal line and the centerline intersect is the spanwise location of the MAC. At this location, draw the MAC reference line parallel to the root and tip chord lines. To determine the CG location, measure the required percentage or distance from the leading edge back along the MAC.

Balancing act!

The Great Planes CG Machine is great for balancing your airplane. It simplifies the final steps of determining your airplane's recommended CG, so you can adjust the model's balance point—a very useful tool for your shop.

Once you have found the correct CG, balance your model accordingly. For low-wing models, balance them upside-down; high-wing models can be balanced right-side-up. You should also balance your model laterally (wingtip to wingtip). Loop a piece of string around the fuselage just ahead of the stabilizer; grab it and the prop shaft, and lift. Add weight to the high wing until the model balances with its wing level. I generally use a piece of clay. Then, when I have the right amount, I weigh the clay and add a metal weight embedded in the wingtip.

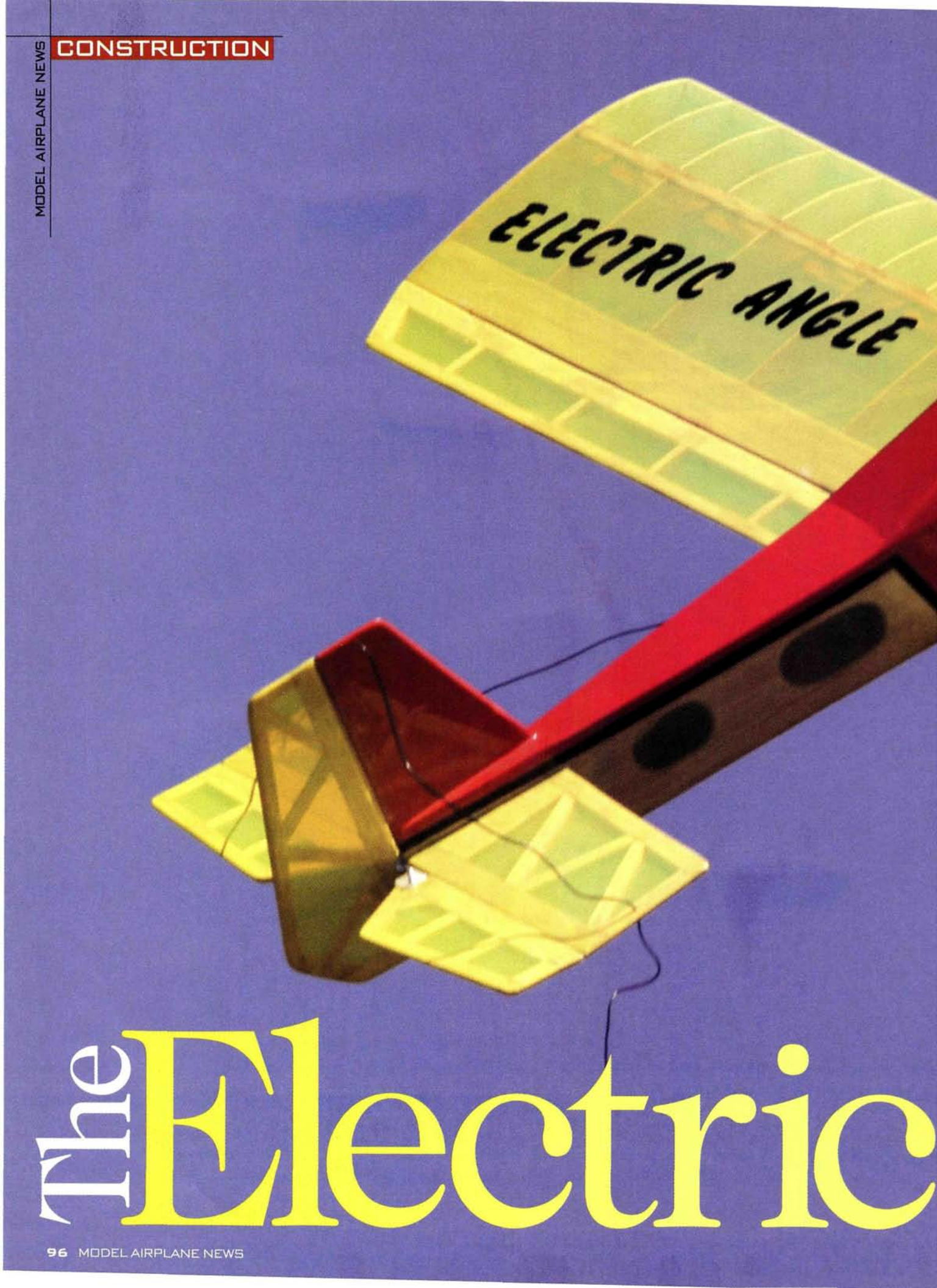


Because it is so important to balance your model at the correct CG location, some ARF models are equipped with a sticker that indicates the wing's proper balance point! Nice touch!

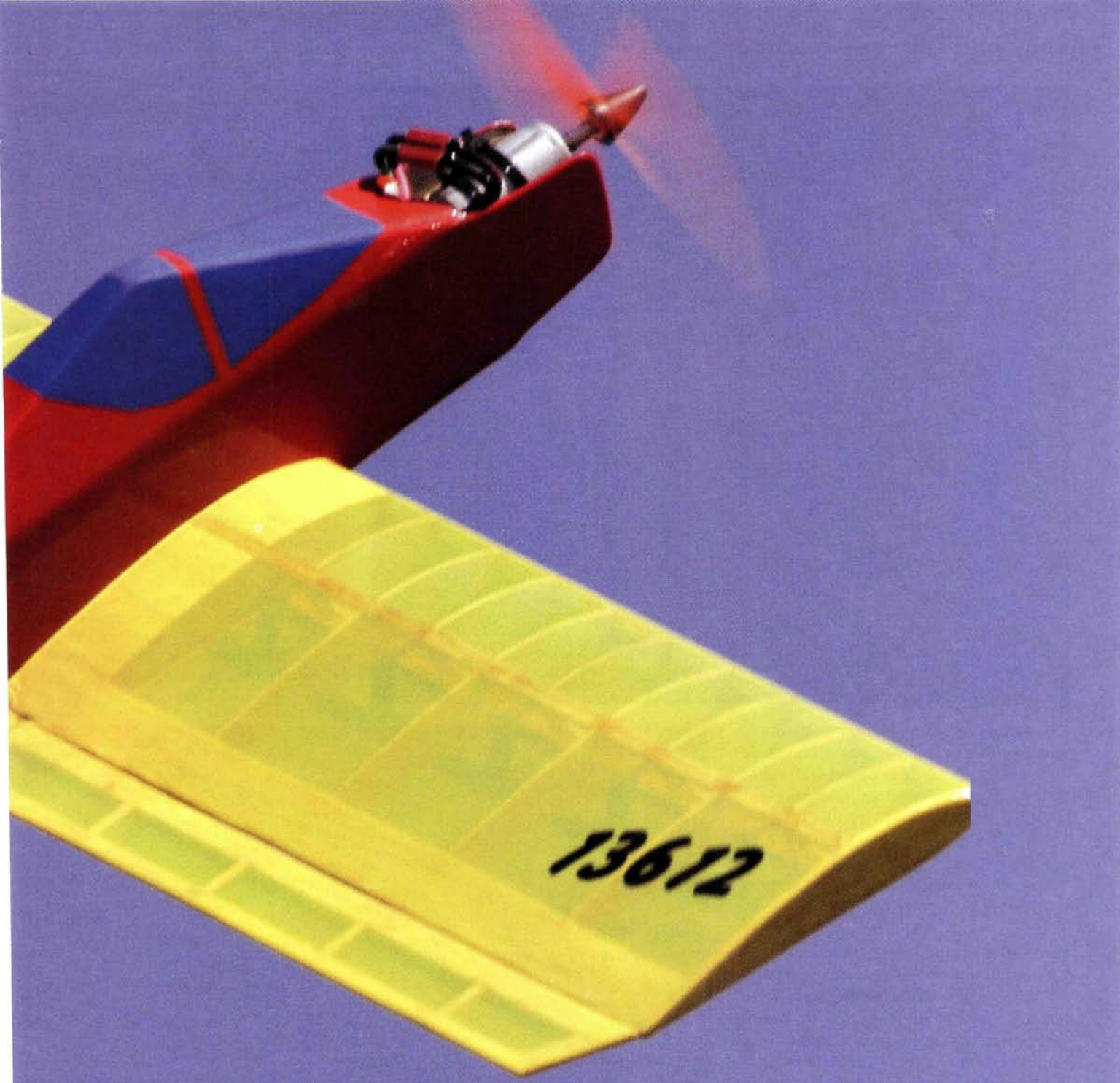
You can balance your model at this point, or if it's more convenient, at any point along a line that extends from the CG and is perpendicular with the MAC. Figure 2 illustrates how the distance between the leading edge and the CG reference line changes because of the wing's taper. It is important to know where the CG should be measured relative to the MAC. Some assembly manuals in ARF kits don't give this information.

Balancing your model at the correct CG location is very important and can make the difference between a successful first flight and a complete disaster. ✈

Great Planes Model Distributors (800) 682-8948; (217) 398-6300; greatplanes.com.



The Electric



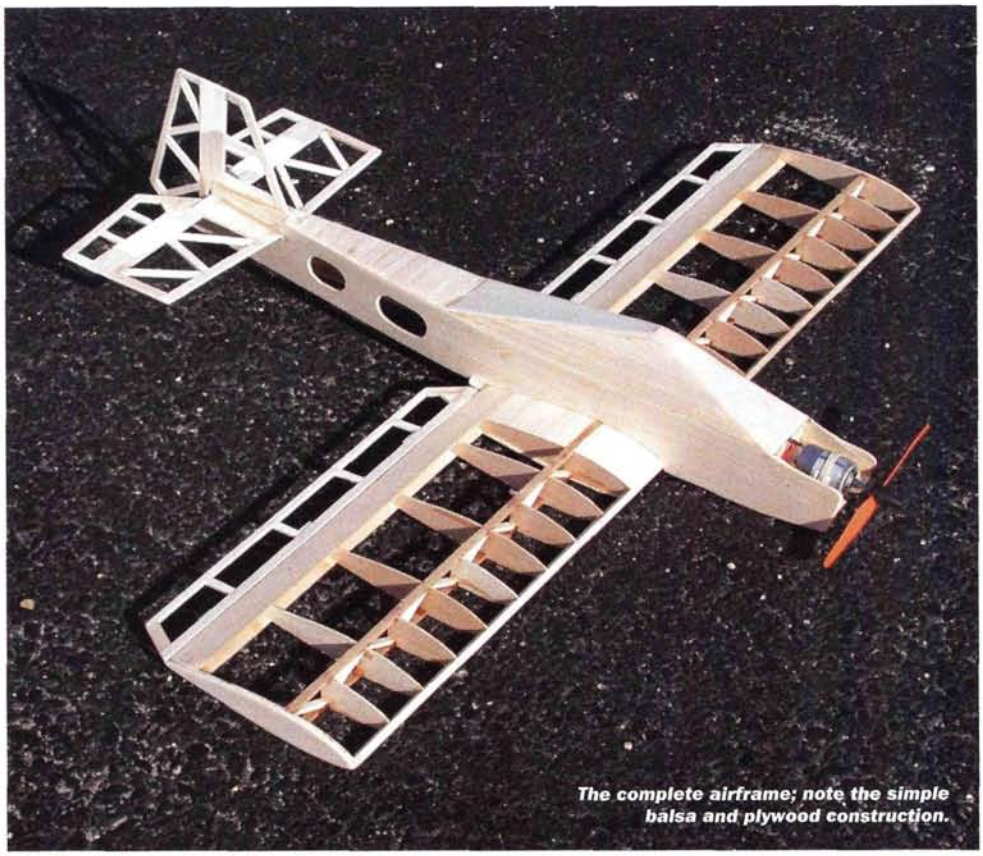
Easy-to-build, Speed 400 sport flyer with aerobatic performance

Angle

PHOTOS BY DICK SARPOLUS & JOHN REID

by Dick Sarpolus

I built my first electric-powered aircraft 28 years ago. Technology at that time sure wasn't what it is today; there was no such thing as an ESC or BEC, the cell count needed for power was high, and I didn't even have a field charger. I have watched the progress of electric models over the years and am amazed at the new electric models' level of performance. After reading many magazine articles and Bob Aberle's book, "Getting Started in Backyard Flying," I was hooked.



The complete airframe; note the simple balsa and plywood construction.

SPECIFICATIONS

MODEL: Electric Angle

TYPE: Speed 400 sport aerobatic

WINGSPAN: 35 in.

LENGTH: 26 in.

WING AREA: 260 sq. in.

WEIGHT: 17 to 20 oz.

WING LOADING: 9.4 to 11 oz./sq. ft.

MOTOR USED: Graupner Speed 480 direct drive

PROP USED: 7x3.5

RADIO REQ'D: 3- to 4-channel (aileron, throttle, elevator, rudder [optional])

RADIO USED: Futaba transmitter, FMA Quantum 6 receiver, GWS servos and ESC

BATTERY USED: 8-cell, 600mAh Ni-Cd

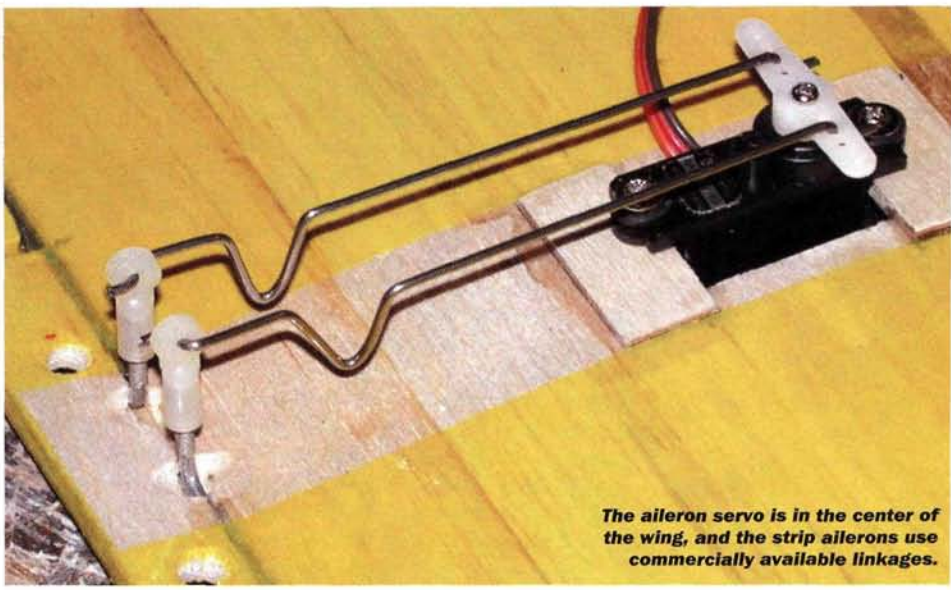
FLIGHT DURATION: 5 to 6 min.

COMMENTS: designed by Dick Sarpolus, the Electric Angle flies fairly fast and offers good aerobatic capabilities. It is not a trainer. Traditional balsa and plywood construction is used throughout, and the wing can be built flat.

I wanted to start small, keep it simple and keep the cost down. But it had to be aerobatic. A direct-drive Speed 400 motor from Graupner seemed so basic and cost so little that I decided to try that first. For the supplies, I went to Bob and Dave Peru at Balsa Products.

I'm all for traditional airplane styling, but I didn't want to go the "stick construction" route. The model is very conventional and has an almost flat-bottom airfoil and generous control surfaces. Overall, I borrowed the styling from some larger designs of mine. I kept the motor installation out in the open to permit easy power-system changes. The battery pack slides into the fuselage below the motor so the pack can quickly be replaced for charging. I use a standard 8-cell, 600mAh Ni-Cd battery pack and a 6V Speed 400 motor. A 2.3:1 geared Speed 400 motor and a Speed 480 are also possibilities. Landing gear isn't needed, and a NiMH battery may save some weight. I'm not a light builder, and the plane could have come out a bit lighter. I used miniservos, but smaller micros are available, and they'd save even more weight.

The Electric Angle gives great small-plane aerobatic fun, and you can fly it in smaller areas. As a builder, you have some choices; they depend on how much you want to spend and the performance you want. Flight-testing showed that with the direct-drive Speed 400, the plane is lively enough for some aerobatic flying. Although there was not a huge difference in performance, the geared motor and larger prop do provide some additional thrust. The direct-drive Speed 480 provides the best performance.



The aileron servo is in the center of the wing, and the strip ailerons use commercially available linkages.

The model is covered with MonoKote.

CONSTRUCTION

Building the Electric Angle is straightforward and doesn't involve anything tricky or difficult. I like to start with the wing,

FLIGHT PERFORMANCE

During several test flights, I found that performance using a direct-drive Speed 400 motor and a 6x5 prop was better than with the 6x3 prop I used first. If you use a geared motor, you'll find that a 9x4.7 prop provides good thrust. I think that the Speed 480 motor turning a 7x3.5 prop is the best setup for overall performance—at least, for now.

In the air, this model flies fairly fast and is groovy; it handles like a larger pattern aircraft. Loops are easy, and the model doesn't show any tendency to snap out of maneuvers. Cuban-8s are fun, and inverted flight is easy but requires some down-elevator to maintain level flight. Power isn't unlimited; 3D maneuvers obviously aren't possible, but the model wasn't designed for that. Nevertheless, you'll have a lot of fun with this economical little flyer.

Control response is good, and the Angle handles reasonably well in windy conditions. Hand-launching is simple; the model will fly right out of a straight toss.

I'm pleased with the Electric Angle; I like its "model airplane" appearance and the ease with which it can be flown. It has very good sport aerobatic capability, and if you build light, it will perform even better. Adding a few more holes in the fuselage sheeting would save a little more weight.

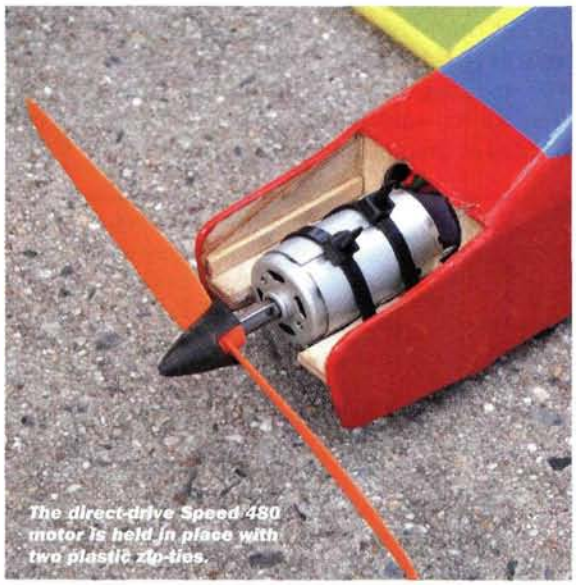
I usually build large, gas-engine projects, so this small, electric-powered job seems like a real lightweight to me. I know I'll do more electric projects; it's sure nice to be able to fly locally in small fields.

and it can be built flat on the building surface. I built my wing flat, but adding an inch or so of dihedral might be worthwhile. Pin the lower spar and bottom trailing-edge sheet to the building bench, and then glue the ribs and false ribs into place. After the glue has dried, glue the top spar, the top trailing-edge sheet and the leading edge into place. Next add the center-section sheeting, the plywood wing-mounting tab and the wingtips. The angled spar webbing between the rib locations is a bit of a pain to cut to size and glue into place, but it greatly enhances the wing's rigidity. You could glue vertical-grain-balsa shear webbing into place before you install the top spar. Build the ailerons, and then install the aileron linkage and the servo in the center of the wing.

Building the Electric Angle is straightforward and doesn't involve anything tricky or difficult.

Begin the fuselage construction by cutting the 3/32-inch balsa sides and their doublers out of 1/16-inch plywood. I cut lightening holes in the plywood doublers and in the rear of the fuselage sides. To assemble the fuselage sides, first install the three plywood bulkheads, and then pull together the fuselage sides at the rear while you're installing the rear bulkheads. Add the fuselage top sheeting next, and bevel the edges of the cockpit-area pieces so they will fit together properly. I left the rear bottom sheeting off until after I had

The control surfaces are hinged with strips of MonoKote, and standard control horns are used on the rudder and elevator.



The direct-drive Speed 480 motor is held in place with two plastic zip-ties.

Here, the model is shown with landing gear made of 5/16-inch music wire, which isn't really needed because the Angle is easy to hand-launch.

You have to cut a hole in the firewall bulkhead to allow it to clear the gear-drive motor.

There's plenty of room in the fuselage for servos—nothing complicated here. Note the wing hold-down plate above the servos.

installed the rudder and elevator pushrods. You won't need a rudder for basic flying, but I felt it was worth the weight of the additional servo for the increased maneuverability.

Assemble the tail surfaces over a flat surface, and then fit the wing to the fuselage and bolt them together. Then add the horizontal stabilizer and vertical fin and align them with the wing. After you've installed the tail surfaces, screw the rudder and elevator servos into place, install the control horns, and make the wire pushrods. I covered my model with transparent MonoKote and also used it for the hinges.

Install the 1/8-inch plywood motor-mount plate, and notch it to fit your motor. I used two nylon zip-ties to hold the motor in place. I originally made an opening in the fuselage bulkhead below the motor to allow easy battery-pack access, but because I had to move the battery pack farther aft for balance, I decided to make the pack accessible through the wing-saddle opening. A hatch on the lower forward fuselage bottom allows access to the battery connectors for charging.

I fly the plane off grass, and hand-launching it is easy. I made a removable wire landing gear that I'm sure would work fine off a very smooth surface, but I haven't yet tried it. Grass is just fine with me.

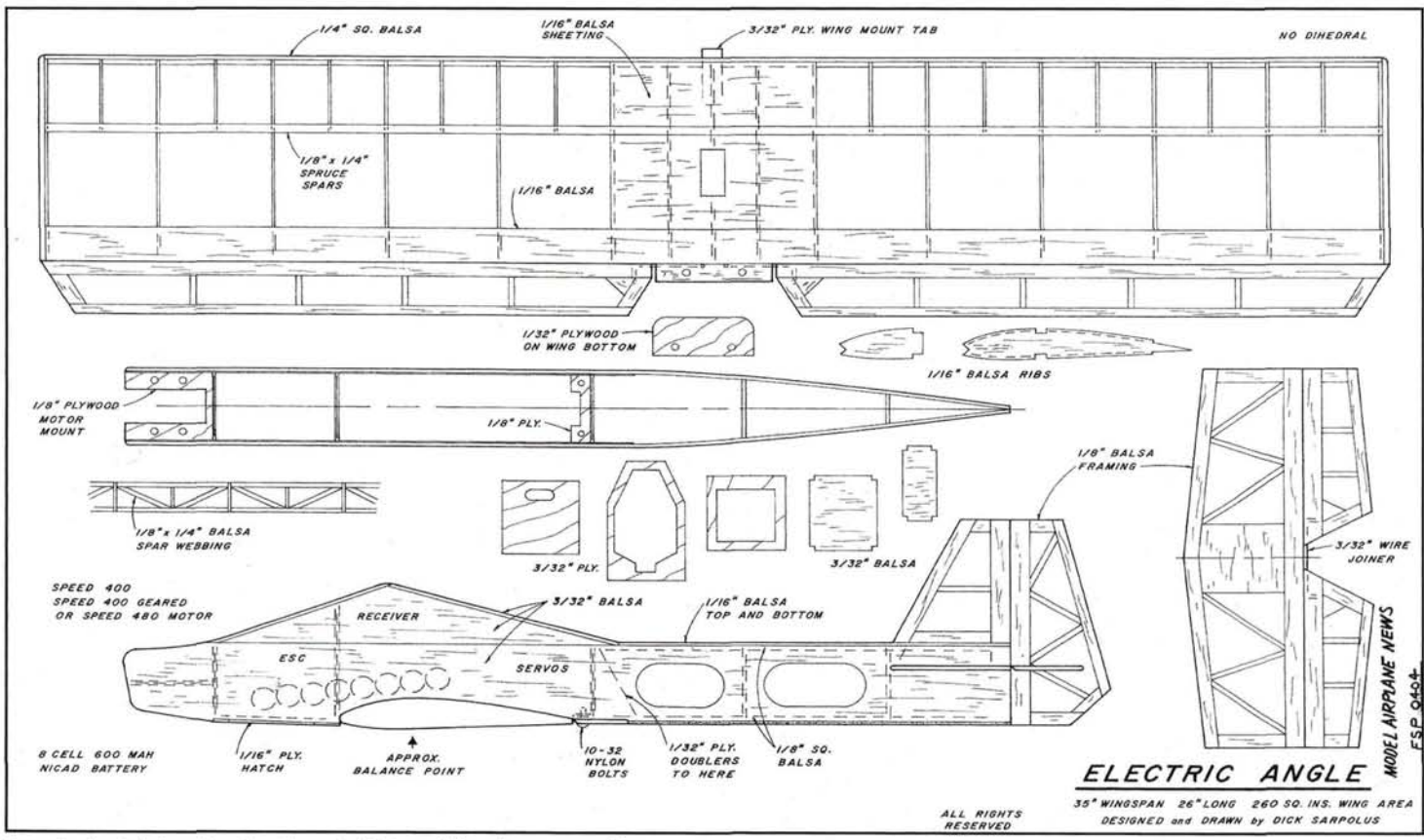
Dick prepares to send the Electric Angle on its way.

Balsa Products *(732) 634-6131; balsapr.com.*
Graupner; *distributed by Hobby Lobby Intl. (615) 373-1444; hobbylobby.com.*
MonoKote; *distributed by Great Planes Model Distributors (217) 398-6300; (800) 682-8948; greatplanes.com.*

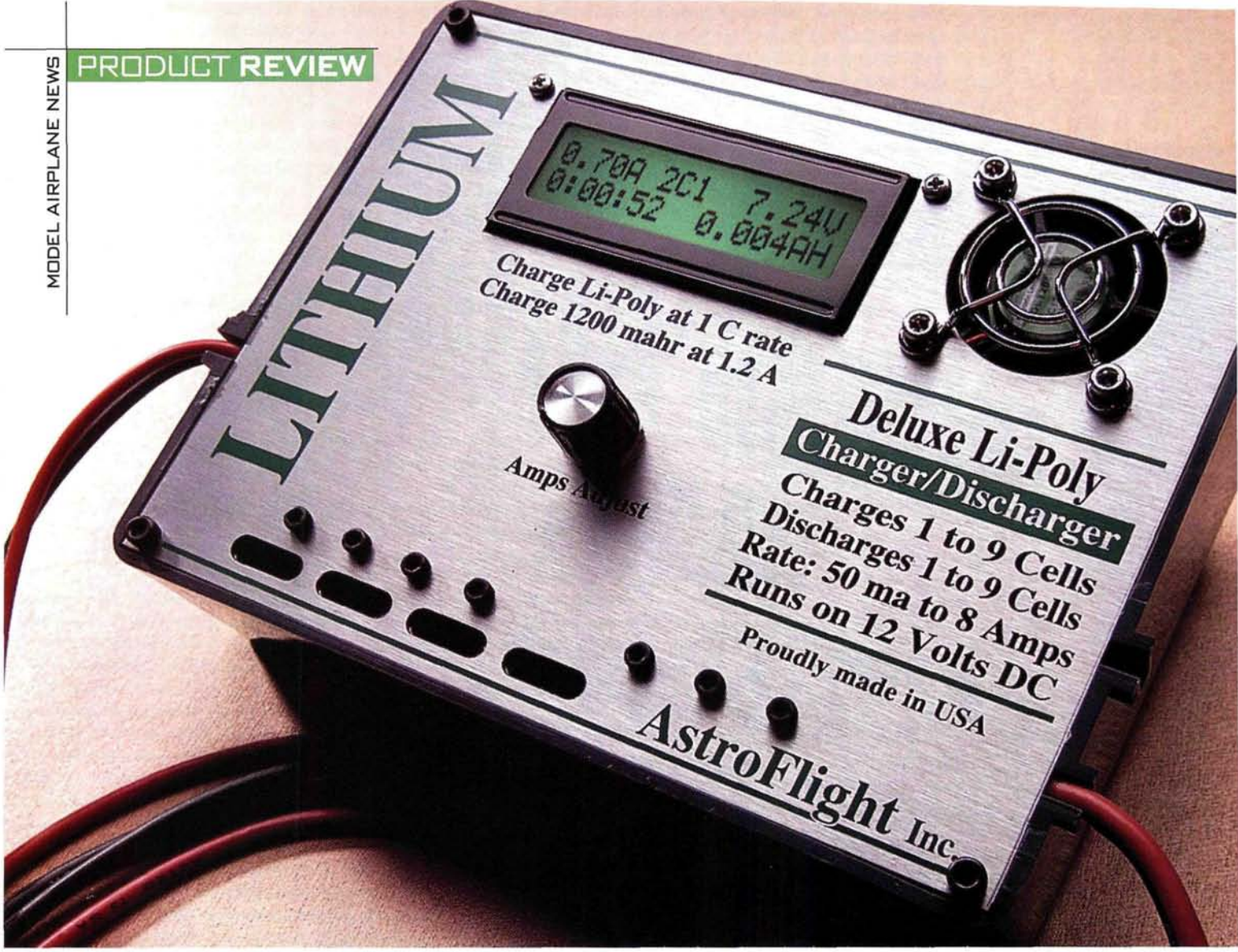
ELECTRIC ANGLE
FSP0404A

Dick Sarpolus brings his many years of sport and aerobatic RC design to this small electric flyer. The Electric Angle flies fairly fast and offers good aerobatic capabilities. It is not a trainer. Traditional balsa and plywood construction is used throughout, and the wing can be built flat.

WS: 35 in.; length: 26 in.; power: Speed 480 motor; radio req'd: 3 to 4 channels; 1 sheet; LD 2. **$19.95**



To order the full-size plan, turn to page 116, or visit rcstore.com online.



ASTROFLIGHT *by Bob Aberle*

Model 109 Lithium *Easy-to-use Li-poly charger*

As lithium-polymer (Li-poly) batteries become more popular, the availability of safe, easy to use Li-poly chargers has become increasingly important. Several such units are already on the market; most can handle up to 4 Li-poly cells, but they are limited to charge currents of 1.5 amps (1500mA). That's fine for Speed 400-size and smaller park flyers, but larger, heavier aircraft require higher-capacity packs, and Li-poly technology is expanding rapidly to meet these needs.

AstroFlight recently introduced a new version of its popular Model 110 Deluxe charger. The new charger/discharger, the Model 109 Lithium, is designed specifically for use with Li-poly cells and costs $129.95.

The Model 109 comes with a pair of 4-foot input cables attached to a 12V DC source. On the output side, a pair of 10-inch wires terminates in an AstroFlight Zero Loss connector. You can purchase adapters directly from AstroFlight, but to be consistent with the rest of my electric equipment, I used Anderson Power Pole (APP) connectors.

The AstroFlight 109 can charge 1 to 9 Li-poly cells at a current that's adjustable from 50mA up to 7.5 amps. It automatically senses the number of cells in the pack and sets the charge current accordingly. It will also discharge 1 to 9 cells at a fixed load (not adjustable) of 1.25 amps.

LCD SCREEN

An LCD screen on the front panel displays the important parameters. When you turn the charger on, the display reads: WAITING FOR BATT. Before you attach the battery, always make sure that the "Amps Adjust" knob is set for zero current (turned fully counterclockwise). When you connect the battery, a series of readings immediately appears on the screen. The charge current (expressed in amps) appears in the upper left corner. Because it will initially be set at zero, you must rotate the "Amps Adjust" knob clockwise to set the charge current to the recommended 1C rate. If your battery is rated at 700mA capacity, set the charge current to 700mA (0.70 amp).

The number of cells connected in series and the mode the charger is operating in

appear in the upper middle portion of the LCD screen. For example, if this portion of the screen reads "2C1," "2" refers to the number of cells, "C" stands for "charging," and "1" means that the charger is in mode 1. This equation is very important, and you must always be observant of it while your cells charge.

When discharging, the word "Discharge" will appear at the upper left of the LCD screen. At the upper right, you see the pack's total voltage. At the bottom left is the total time on discharge, and at the bottom right is the capacity being taken out of the battery.

In the upper right corner of the LCD screen, the battery pack's total voltage is displayed. A 2-cell pack will start in the 7V range and will peak at 8.4 volts (4.2 volts per cell) when fully charged.

The lower left corner of the LCD screen shows the total charge time, e.g., 1:43:15, and the capacity (Ah) applied to the battery as it's being charged appears in the lower right-hand corner of the screen.

MODES

When the pack is first connected and charge is initiated, the 109 will be in mode 1, during which the charger senses the number of cells connected in series. It lasts for exactly one minute, and then the charger switches to mode 2.

In mode 2, the 109 checks the battery voltage every minute until the battery reaches 4.2 volts per cell. At that instant, it switches to mode 3, and the battery is essentially 90-percent charged. For the remainder of the charge, the 109 will turn itself on and off at the appropriate intervals so as not to exceed 4.2 volts per cell. If mode 3 is not reached within one hour, the charger is programmed to stop charging, and the LCD will read "TIMED OUT." When the battery is fully charged, the Model 109 shuts itself down and indicates completion with three loud beeps and "CHRG DONE" on the LCD screen. At that point, the charger output is completely off. When I charged cells at the recommended 1C rate, the packs remained cool.

DISCHARGING

To discharge the battery, you must first connect the battery pack to the output with everything turned off, and then turn

When you begin to charge a 2-cell, 700mAh E-Tec Li-poly battery, the charge current (upper left onscreen) is set to 0.70 amp (700mA). In the top center, you see "2C1" which means a 2-cell pack is being charged, and the charger is in mode 1. At the right is the startup voltage of 7.24 volts, and the voltage will increase until the maximum 8.4 volts is reached. At the lower left is the time on charge, and the charge capacity that has gone into the battery appears at the lower right.

on the 12V DC input power. When connected, the LCD screen lights up, the word "DISCHARGE" appears in the upper left corner, and the 109 begins discharging at a fixed 1.25A load. The upper right corner of the LCD shows the total pack voltage. The total time of discharge appears at the lower left, and the battery's capacity (Ah) is displayed in the lower right corner of the screen.

Three beeps indicate the conclusion of discharging, and "DISC DONE" will appear on the screen. The 109 is programmed to discontinue discharging at 1$\frac{1}{16}$ of the starting voltage. A 3-cell Li-poly pack may discharge down to 8.46 volts (2.82 volts per cell), which is slightly lower than 1$\frac{1}{16}$, but anything above 2.5 volts per cell is generally considered acceptable. It is my understanding that this voltage cutoff point may be increased. When the load is removed, the battery does recover somewhat. During discharging, the packs became slightly warm but never hot.

When the battery has been completely charged, the screen will read "CHRG Done," and the charger will shut off automatically. At that point, the voltage is a steady and exact 8.40. Total time to reach full charge was 01:43:15. Total capacity going into the battery was 0.698Ah or 698mAh, which is almost dead-on the rating of the battery at 700mAh.

A few words of caution: I would not attempt to discharge 45, 130, or 145mAh Li-poly batteries. A fixed load of 1.25 amps may be too much for these cells. I therefore recommend that you not discharge cells with less than a 300mAh capacity.

SPECIFICATIONS

MODEL: 109 Lithium Digital Peak Charger/Discharger

MANUFACTURER: AstroFlight Inc.

TYPE: 1- to 9-cell Li-poly charger/discharger

INPUT: 12V DC (from car battery) or a separate AC-operated power supply

INPUT CABLES: 4-ft., 13-gauge wire with alligator clips

OUTPUT CONNECTION: 10-in., 16-gauge wire with AstroFlight Zero Loss connector

DIMENSIONS: 7x5x2$\frac{1}{2}$ in. (tapers down to 1$\frac{3}{4}$ in.)

CELL CAPACITY: 50 to 8000mAh

CHARGE CURRENT: continuously variable from 50mA up to 7.5A

DISCHARGE CURRENT: 1.25A fixed

PRICE: $129.95

FEATURES: ease of operation; automatically senses and sets the number of cells connected in series; high current output up to 7.5 amps.

COMMENTS: this unit can charge and discharge Li-poly cells, but each function must be handled separately. It should not be used with Ni-Cd and NiMH batteries. The discharge load is fixed at 1.25 amps and is not adjustable.

HITS

- Large charge-current range.
- LCD screen monitors all necessary battery parameters.
- Ease of operation.
- No complicated menu system.

MISSES

- None.

SUMMARY

This is probably the best Li-poly charger that I've ever used. At the recommended 1C rate, the AstroFlight Model 109 will generally charge a battery to 90 percent of its rated capacity in one hour, and in less than two hours, the battery will be fully charged. In most cases, you can stop charging after one hour and use the 90-percent-charged pack. The folks at AstroFlight did an excellent job developing this Li-poly charger/discharger to perfectly suit the needs of modern electric modelers.

AstroFlight (310) 821-6242; astroflight.com.

by Dick van Mourik

Working with aluminum

Many of us have a weak spot for the classic biplanes of the '30s. Not only do they represent the last of the biplane generation of fighters, but to many, they also epitomize the utmost in aircraft design. Many aircraft of the so-called Golden Age are known for their striking color schemes, often covered in natural metal with brightly colored roundels and striping. But when it comes to making models, many people are—regrettably—put off by such subjects because of the difficulty involved in re-creating a realistic natural-metal look.

Some commercially available paints and coverings are said to produce a realistic-looking chrome finish, but when it comes down to it, you can't beat the real thing. Only one thing can be substituted for metal: metal.

During construction of my Hawker Fury, I decided to put this theory to the test using a variety of materials. First, I tried lithoplate. For those who are unfamiliar with this product, it is a very thin (about 0.256- and 0.128-inch-thick) aluminum plate used in the offset printing process. The most common way to form aluminum (and many other metals) is to heat it and then let it cool so it can be bent or hammered to shape. Unfortunately, as one can imagine, materials as thin as lithoplate are not very conducive to being hammered, so I was soon forced to abandon that option.

Molded-aluminum buffet trays have proven to be very useful for modeling purposes. They are cheap, light and made of very soft material. This is the material I selected to form most of the Fury's cowl. You could also use several other varieties of aluminum in various thicknessness; many are available at modeling trade shows and scale fly-ins.

Here, the aluminum is in the later stages of the annealing process. After you've rubbed the piece with soap, heat it until the soap residue turns black.

CUTTING

Before you cut the aluminum, it's a good idea to make templates out of card stock. Remember to cut the templates (and the metal) slightly larger than needed; this allows you excess room to clamp the aluminum into position and to account for any errors that may occur during assembly. The actual size of the individual panels is not as important as are the positions; try to replicate those as accurately as you can. For the most part, I was able to do that on the Fury's cowl with the exception of the panel on the underside. Though it was supposed to be a one-piece panel, I had to split mine lengthwise. Fortunately, most of the separation line is concealed by the hole I had to cut in the cowl for the engine and by a non-scale but very convincing-looking hatch.

Aluminum can be cut with either a pair of scissors or a sharp hobby knife. When using a knife, make several passes and simply snap the pieces apart. Do not worry about the rough edges this will create; they can later be smoothed with steel wool.

SHAPING

First and foremost, make a plug on which to form the cowl. Old newspapers and magazines work well here, but if you make your own fiberglass cowl, as I did on the Fury, you can use the negative mold to form the aluminum. This is probably the simplest method; it is, after all, easier to form in a negative shape than over a positive one.

Several tools can be used to help shape the aluminum, but I prefer to use a wooden spoon as a shaping tool. Its convex shape lends itself nicely to such a project, and the smooth surface will not scratch the aluminum. Plastic jar lids and screwdriver handles are also suitable. Metal tools are another possibility, but they are also capable of scratching the soft aluminum.

When rubbing the aluminum to shape in (or over) the plug, always start from the center and work toward the outside; gently rub out any wrinkles as you go.

When forming double curved pieces such as cowls out of aluminum, it pays to think in reverse. For example: when forming a piece of aluminum sheet over a ball and trying to bend it into shape, you'll notice that it tends to wrinkle wherever there is a surplus of material. The most important thing

ANNEALING

Heating aluminum to a certain temperature causes it to release its inner tension so that it can be molded to shape; this process is called annealing. There are two commonly accepted methods of annealing, and you begin both by rubbing ordinary hand soap (wetted) on the aluminum sheet. The soap acts as a temperature indicator (much like chalk does for steel). The sheet can then be gently heated with a blowtorch until the soap blackens. (Note: the soap must turn dark brown or black.)

At this point, the two methods differ. In one, you allow the aluminum to cool at room temperature; in the other, you submerge the heated sheet in cold water. Despite several attempts, I have not been able to determine which method is better; I suspect that it merely depends on the kind of aluminum being cooled.

The blisters on the cowl can be faithfully reproduced using the aluminum material featured here. It helps to first make a template.

I've found a wooden spoon to be quite a useful tool. Gently rubbing it across the aluminum will help to eliminate wrinkles.

Silicone sealant makes an excellent adhesive for this kind of metal. Be sure to comb it out into a thin, even layer as shown here.

to learn about this stretching isn't that there's excessive material where it wrinkles but that there's a lack of material where it doesn't. We cannot prevent the aluminum from wrinkling, but we can stretch the aluminum and rub out the wrinkles.

ODDS AND ENDS

Forming aluminum causes it to re-harden, and that makes it neccesary to anneal it every couple of minutes. In the beginning, the aluminum will harden fairly quickly, so don't stretch the panels to their limits. It's far better to work a little bit at a time and continually repeat the annealing process; it will not affect the aluminum's characteristics. You'll be surprised by the extent to which aluminum can be stretched, as evidenced by the air intake on my Fury's cowl; it was formed from a piece of 1/64-inch aluminum sheet. Patience is key here!

If working with a balsa cowl, it must be filled with several coats of filler or a single application of epoxy resin and then properly sanded before you attach the panels. Fiberglass and plastic parts do not require any treatment prior to sheeting.

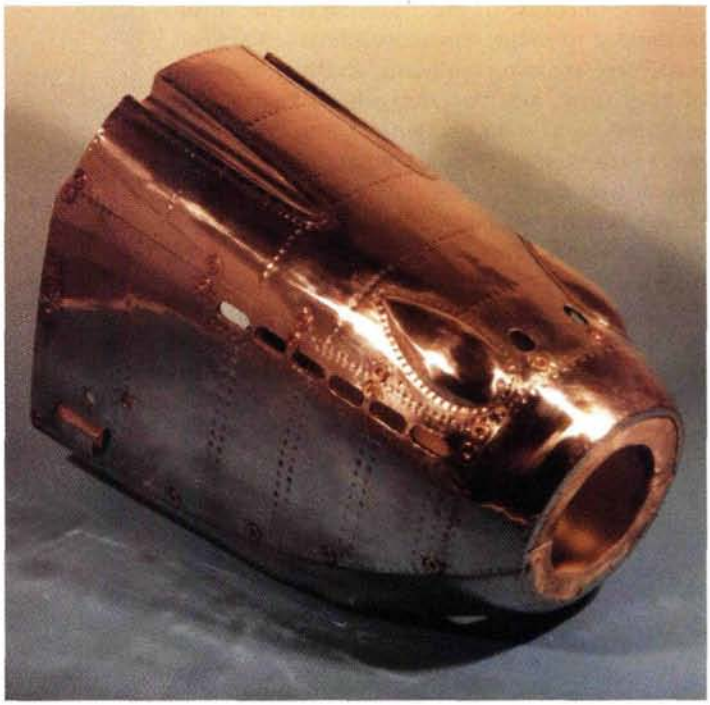
You may want to prime the panels before you glue them permanently into place. Depending on the thickness of the material being used and its intended location, several gluing methods may be used. For small pieces, thick or medium CA will work fine; for panels that will not overlap, some kind of contact cement would be appropriate; and for large panels, I've found silicone bathroom sealant to be a good choice. It's necessary to spread the sealant over the entire sheet with a comb-like spatula. The silicone sealant will, most likely, not require clamping; but if it does, always protect it with a piece of soft wood before you tighten the clamp. When applying the panels, be sure to glue them shingle-style in the direction of flight; this will help prevent fuel from seeping underneath them.

When working with the aluminum, it is virtually impossible to prevent the occurrence of scratches, small dents and other blemishes. You could sand the panels down until they are perfectly smooth, but given the blatant irregularities in the metal paneling on most full-size planes, the final result may be more realistic with the scratches and dents left in place.

The most notable details on a panel are the rivets. Flush rivets can easily be made with a piece of small tube, but raised rivets must be made from the inside with a piece of round-tipped rod or something similar in shape. After making indents, turn the panel around, and slightly press back each rivet by fitting a small tube around the dent. This helps define the shape of the rivet and makes for a very convincing-looking scale detail.

The reinforcements around fastening points on full-size aircraft from the Golden Age are also prominent details that contribute greatly to a scale model. For my Hawker Fury, I made the reinforcements out of brass washers, which I simply glued onto the cowl. For an added dose of realism, you could drill four equally spaced holes and insert a pin into each.

The final step is polishing. This is what makes the aluminum look like real metal. If at all possible, avoid the use of sandpaper during this stage; it will scratch the soft aluminum. Start by washing the panels with a moist cloth to remove most of the dirt. For coarse polishing, use a scouring pad of steel wool or a fine Scotch-Brite pad. As a final step, you could use a chrome polish like that used on cars, but for a real state-of-the-art finish, nothing beats a polishing disc.



The completed cowl is well worth all the effort. The scale rivets and reinforcements really add to its overall appearance.

CONCLUSION

It may seem strange, but adding a metal top surface does not add much more weight than using primer and paint. The aluminum cowl featured here weighs only 2 ounces, though the silicone sealant is fairly heavy. All in all, the tradeoff is equitable: sacrifice a total of 6 ounces of weight gain for a beautifully detailed scale cowl. Seems fair to me!

Electric Flight 101: basic wiring

Over the last few months, we've looked at some great glow-to-electric model conversions and talked about installing electric motors. This time, I describe how to wire a power system. If you've been thinking about converting your model to electric, this column will set you right up!

Fortunately for us, electric flight has matured to a point where we can now choose from some really nice plug-n-play power systems that eliminate most of the guesswork. Whenever possible, try to use a preassembled power-system package. It's no biggie to solder and wire your own system together (we'll look at that later), but when you first start out, plug-n-play equipment is hard to beat!

I'll begin with a disclaimer: we are not designing and building space vehicles for NASA! This column is not meant to be a complete course in electrical engineering; we'll use some widely accepted rules of thumb. The "close enough" approach is good enough for our purposes.

BATTERIES AND VOLTAGE

For years, we've used Ni-Cd batteries, and life was pretty easy. Today, however, technology has brought us nickel-metal-hydride (NiMH) and lithium-polymer (Li-poly) battery packs, so we have more choices and need to learn how to use each properly. Each type has some advantages and disadvantages. Let's look at the basics.

We can treat NiMH and Ni-Cd batteries in pretty much the same way. Ni-Cds have always been forgiving of abuse, but the newer NiMH cells are less forgiving. Both supply 1.2 volts per cell without a load and about 1 volt under a load. When we discharge them, our chargers/cyclers cut off the current at about 0.9 volt per cell. This prevents the cells from being damaged. According to the cell's capacity and chemistry, manufacturers recommend a maximum charge and discharge current to protect the cells. More on that in a minute.

The newest battery to hit the electric-model market is the Li-poly cell. I could devote an entire column to them but will focus on the basics for now. A fully charged Li-poly cell has 4.2 volts and should never be discharged below 3 volts per cell. Its nominal voltage is 3.7, and it stays fairly constant under load. Unless you plan to stick with park flyers, I recommend that new electric flyers not use Li-poly cells on their first effort. Li-polys are extremely unforgiving of errors; if overcharged, they can explode and catch

All sorts of glow-powered models can be sucessfully converted to electric power. Here, a Hangar 9 Cessna 182 Skylane is seen flying at the 2003 NEAT Fair electrics-only meet.

fire. A good source of Li-poly safety information is available at radicalrc.com.

BATTERY SAFETY

I know; nobody wants to read safety stuff! It just isn't fun, but with electric models, it is very important. Never leave your battery packs unattended while they are being charged or discharged. Ni-Cd and NiMH cells have vents, but they can burst violently when something goes terribly wrong. Read the directions carefully and monitor your charger, and your batteries will have a long and happy life.

RATES

Battery manufacturers list recommended charge and discharge rates in terms of "C." That's just a simple way of referring to a cell's capacity. We'll use a 2000mAh Ni-Cd for our examples. To charge at a 1C rate, set the charger for 2 amps (2000mA), and the cell will be fully charged in 1 hour. If we wanted to charge it in 15 minutes, we'd have to increase the rate to 4C, or 8 amps. When we use our radio chargers to charge our transmitter and receiver packs, they charge at a 1/10C rate. This prevents damage to the packs in case we forget to unplug them for a day or so. That's also why it takes so long to charge our radios. Lower rates help balance a battery pack's cells, so I always charge my new packs at 1/10C for the first time.

When we fly our models, the discharge rates can be very high, so we need to use the correct type to stand up to the abuse. A plane that draws 30 amps from a 2000mAh pack will discharge the cells at a 15C rate. That's why the packs feel so warm when we've finished flying.

WIRING THE SYSTEM

The two types of basic wiring circuits that everything else builds on are series and parallel. To simplify this even further, if two cells are wired in series, the positive (+) terminal is connected to the adjoining negative (-) terminal. Figure 1 shows two 1.2V 2000mAh Ni-Cd cells wired in series. This is the most common way cells used to form our battery packs are wired together. To obtain the voltage we want, we simply add cells to the pack. Four 1.2V cells wired in series produce 4.8 volts. The two cells in Figure 1 will produce 2.4 volts, but the total capacity remains at 2000mAh.

Figure 2 shows two cells wired together in a parallel circuit. The positive terminals are wired together, and the negative terminals are wired together. This results in a pack that produces 1.2 volts but has a combined capacity of 4000mAh.

So, in a nutshell: when cells are wired in series, the pack's total voltage is the number of cells times 1.2 volts, and its capacity is the same as any one cell in the circuit.

When cells are wired in parallel, the total voltage is equal to the voltage of one cell, but the capacity is the sum of all the cells' capacities.

The photo at right shows a complete power system wired together. For simplicity, there aren't any fuses or arming switches. For many basic setups, however, it is this simple. For safety, always turn your transmitter on first, your receiver second, and connect your battery pack third. When you plug the 20-cell pack into the controller, you have armed the system. Most of today's electronic speed controls (ESCs) prevent false starts; if the ESC doesn't read a signal from your receiver when you connect the battery pack, it will not supply power to the motor. But don't just trust your ESC; always disconnect your motor pack before you turn off the receiver at the end of a flight.

A completely wired motor power system. The 20 cells are housed in two MEC solderless power tubes (10 cells each), and the Aveox motor is controlled by the H360 ESC.

WHAT ABOUT BEC?

Many ESCs use a voltage-regulator circuit that provides power to your receiver from the motor pack. This battery eliminator circuit (BEC) allows you to omit the receiver pack to save some weight. Be sure to check the ESC manufacturer's specs for the maximum number of cells and servos you can use with the controller. Important note: never, ever install a fuse between the battery pack and the ESC when using a BEC. If the fuse blows, the power to your radio will be lost, and you will lose control of your airplane.

Many ESCs come with two ratings: one for use with the BEC and one for use without it. To disable the BEC, just remove the red wire from the receiver lead. Some people cut it, and others prefer to remove the wire connector from the plastic housing. This way, you can plug it back in if you want to use the BEC later on. Whichever method you use, be sure to insulate the end of the red wire so it doesn't cause a short.

CONCLUSION

This information forms the basic knowledge you'll need to install an electric motor system in your plane and operate it properly. Remember these safety points:

- Always turn on (arm) the transmitter first, the receiver second and the ESC third.
- Double-check your wiring before you plug anything together.
- Always stay clear of the prop. Assume it can come alive at any moment.
- Bench-test your setups without the prop attached.
- Always turn off (disarm) the controller before you turn the radio off.

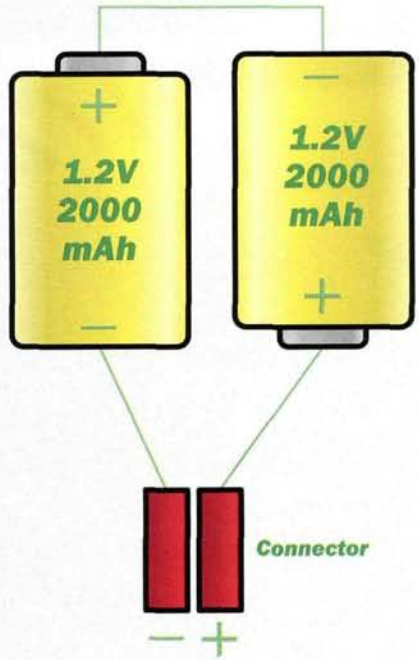
Next time, we'll discuss more complex circuits such as multi-engine setups, so stay tuned and fly safe. See ya!

Aveox Electric Flight Systems (818) 597-8915; aveox.com.
MEC (Model Electronics Corp.) (425) 255-4269; (866) 507-9956; model electronicscorp.com.

The two most popular cell types used in electric models are Ni-Cd and NiMH.

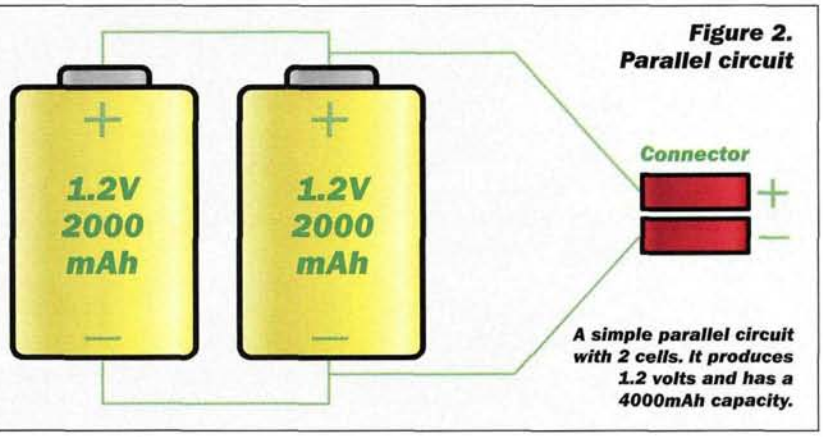
To disable the BEC circuit in an ESC, simply cut or remove the red center wire in the ESC lead.

Figure 1. Series circuit



A simple series circuit with 2 cells. It produces 2.4 volts and has a 2000mAh capacity.

Figure 2. Parallel circuit



A simple parallel circuit with 2 cells. It produces 1.2 volts and has a 4000mAh capacity.

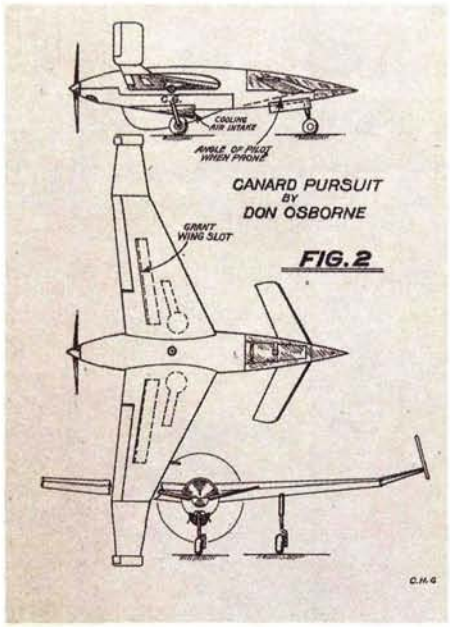
Classic Model Airplane News

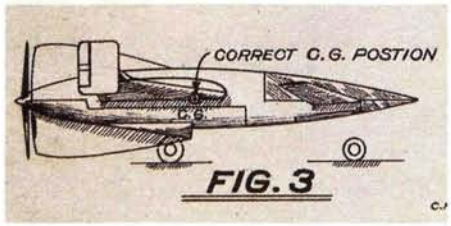
by Jaime Studd

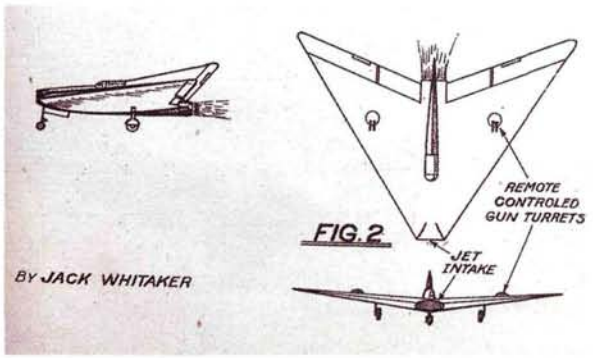
DESIGN FORUM

Written by longtime editor and model aviation pioneer Charles H. Grant, "Design Forum" appeared on the pages of *Model Airplane News* from November 1945 to January 1951. Based on an earlier Grant column, "The Aerodynamic Design of the Model Plane" (February 1932 to September 1935), "Design Forum" taught readers the importance of design in ensuring that a model performs well in flight. Grant wrote, "Practice makes perfect. So 'Design Forum' is established to provide a little practice in the art of creating airplanes ..." Thanks to a creative approach and the invaluable information it provided, "Design Forum" earned itself an honored position in the *Model Airplane News* history books as one of the most memorable columns ever to grace its pages.

The "Design Forum" column in the August 1947 issue highlighted Don Osborne's "Canard Pursuit." The canard looked as if its roots came from the Curtiss XP-55 Ascender or the Japanese Kyushu J7W1 Shinden—the only canard fighter of WW II.

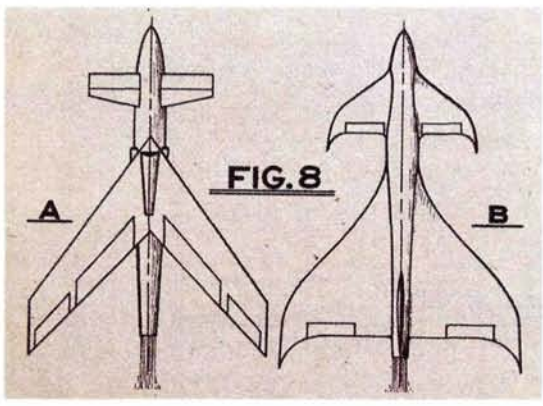




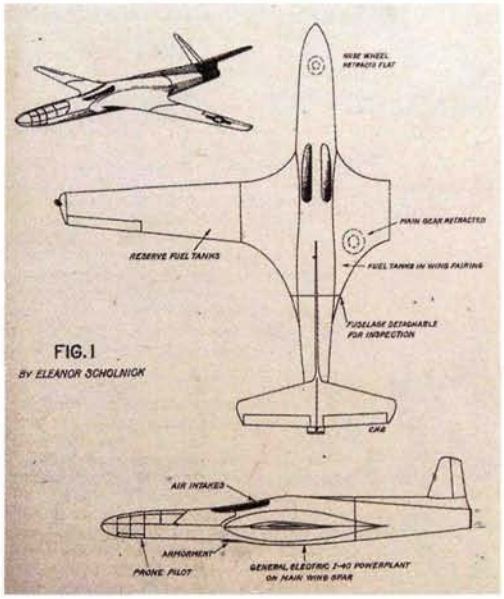


If you look closely, you can see that the roots of Jack Whitaker's November 1946 layout are reminiscent of German engineer Alexander Lippisch's early 1940s delta designs. Data from Lippisch's tests were incorporated into Convair's F-102 Delta Dagger and F-106 Delta Dart.

A design by a woman engineer was first featured in "Design Forum" in the August 1946 issue. Eleanor Scholnick's plane was to be a high-speed pursuit defender powered by a jet engine. It looks remarkably like a Bugatti R-100 racer from the late 1930s.



After WW II, speed was the name of the game, and Paul Audette's projects in the January 1948 issue resembled some of the latest experimental high-speed designs of the era.



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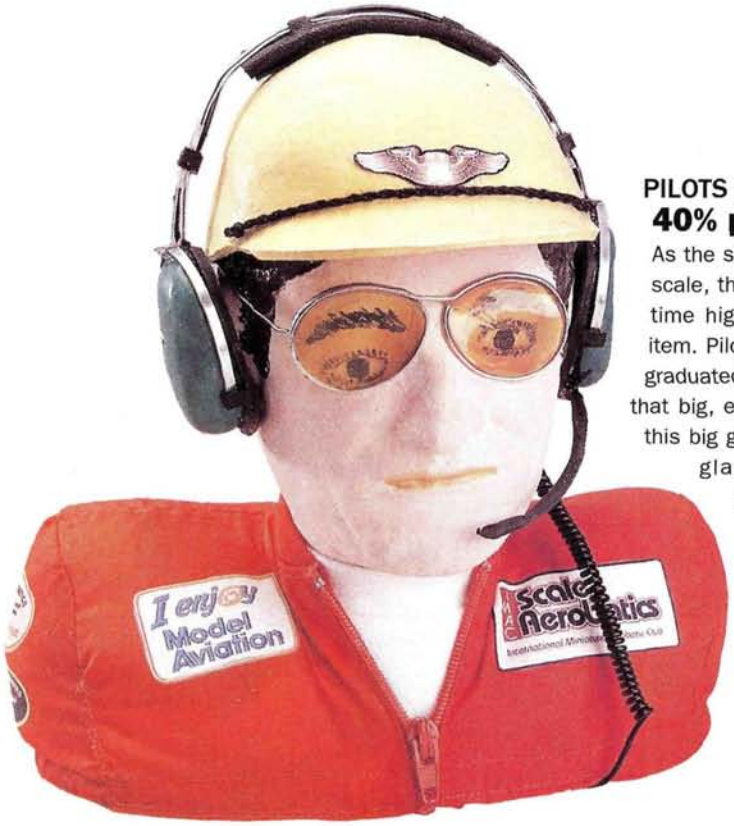


PILOTS BY DIANE

40% pilot figure bust

As the size of giant models increases to more than 25- to 30-percent scale, the need for really big pilot figures and busts is hitting an all-time high. A 40-percent pilot bust isn't your everyday hobby shop item. Pilots by Diane, maker of unique handmade scale aviators, has graduated to the big time and now offers 40-percent-scale busts to fill that big, empty space under the canopy! Like all of Diane's offerings, this big guy is hand-painted, comes with removable accessories (sunglasses, hat and earphones) and features lightweight construction. The base is made of plywood so it can be securely glued or screwed into place. The jacket and turtleneck shirt are hand-sewn, and the zipper is real. Custom patches and logos are also available. Measuring 7¼ inches high and 7 inches across, this big fella is just the ticket for any 40-percent model. Prices for pilot busts start at $50, and the 40-percent figure costs $140. Call for custom accessories and patches.

—Gerry Yarrish

Pilots by Diane P.O. Box 1865, Champlain, NY 12919; (450) 246-4543.

CASTLE CREATIONS

Phoenix-45 brushless, sensorless ESC

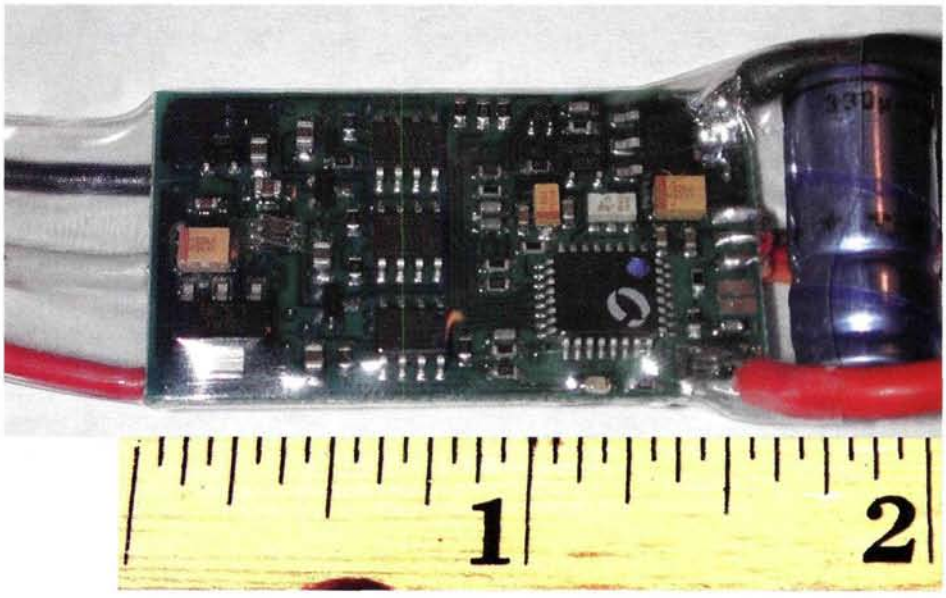
Over the years, electronic speed controls (ESCs) have continued to get better and better. The latest designs in brushless, sensorless controllers, however, have really raised the bar.

I recently needed an ESC that could handle 45 amps and 20 cells (24 volts). Castle Creations customized its new Phoenix-45 ($119.95) to handle the 20 cells for only an additional $10. This ESC is exceptional, and to make it even more versatile, there are six features that can be programmed by the user. You can set the low-voltage cutoff and the "over-current" protection points, select the type of brake function and adjust the throttle range, the motor timing and the switching frequency. This last one is particularly attractive because it allows you to use all brands of motor, regardless of their switching preference.

The Phoenix-45 is small and weighs only an ounce before you add your own connectors. The instructions are complete and easy to follow. If you're not sure whether the Phoenix-45 is right for your application, you can download the owners' manual from the company's website to make certain it's what you want before you order it.

I've used several Castle Creations ESCs and have always been happy with their performance. The Phoenix-45 comes with a one-year warranty, and Castle Creations offers a flat-rate fee of $40 for repair or replacement in case you damage the ESC in a crash or do something that isn't covered by the warranty. With great customer service support, reliability and construction, Castle Creations products are leading the way. — *Greg Gimlick*

Castle Creations (785) 883-4519; castlecreations.com.



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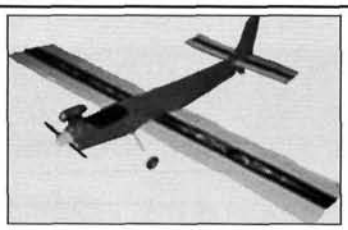

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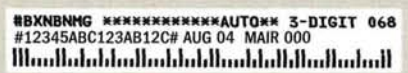

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BY STAN LYONS

FINAL APPROACH

A first-class airliner

PHOTOS BY PHIL KARAFILIS

Frank Scott of Susanville, CA, has always been involved with aviation, whether in his 34-year career with Pan American World Airways or as a modeler during his 20 years of retirement. Now 79, he prefers to build rather than fly, and Frank's Lockheed Model 049 Constellation ("Connie") is the latest in a series of multi-engine, large-scale aircraft that include a DC-4 with four Morton M-5 radial engines he built more than 35 years ago, a Nick Ziroli Douglas DC-3, a 14-foot Convair B-36 with six SuperTigre 91s and a 16-foot Hughes HK-1 "Spruce Goose" flying boat powered by eight Magnum 28s.

The Lockheed Constellation is probably the most recognizable four-engine airliner of the prop-driven era. The Connie's triple tail stands out as this elegant skyliner's most visible identifying mark. Frank built his Connie from his own plans drawn up from 3-views and pictures; it's the early 049 version that was the first Connie to be used commercially. It has a wingspan of 14 feet and weighs 69 pounds. Frank builds all of his airplanes using traditional methods: the main structure is made of balsa and plywood formers and balsa stringers, with ⅛-inch-balsa sheeting glassed with light fiberglass cloth. The finish is automotive paint and Coverite Black Baron paint done up to resemble a Connie that Pan American operated back in 1947—one that Frank actually worked on back then. Frank created all the markings and either spray-masked or hand-painted them.

The entire triple-tail assembly is removable: the outer wings come off, and the wing center section is then removed from the fuselage. Frank uses transport boxes he designed for moving the Connie from home to the field. The Connie features retractable landing gear that Frank designed himself and uses Robart air cylinders to actuate the struts. The flaps are true to prototype, as they are a Fowler design; they travel on a rack-and-pinion drive with a single motor in the center of the wing and move in a slow arc to provide more wing area as the flaps are extended. This type of flap is usually difficult to do, but Frank enjoys a challenge, and the result is a perfectly operating flap system.

The engines are O.S. 1.08 FSRs with 20-ounce tanks—one in each nacelle. All four throttles are slaved to one channel on the radio and also control onboard glow-drivers to keep the plugs hot at low throttle. Frank plans to use 3-blade props at a later date; the current props are Zinger 14x6 2-bladers with Tru-Turn spinners.

Flight engineer Paul Kirby holds the Connie's tail as he and pilot Stan Lyons go over last-minute instructions.

The radio system uses dual Hitec receivers, battery packs and a servo on each flying surface. The transmitter is a Futaba 7UAF. As the servo leads are run to each of the servos at their respective surfaces, Frank wired in a complete wiring harness to connect the receiver to the servos. He uses a single multi-pin connector on each removable assembly to connect all the wiring.

The Connie's first flight was made at the Tracy Skyliners' R/C field at New Jerusalem airport near Tracy, CA. Frank came from Susanville, and the pilot, Stan Lyons, arrived from Brentwood. The Connie does not have brakes, so Paul Kirby, the flight engineer and backup pilot, walked it down to the departure end of the runway. Phil Karafilis, a retired TWA captain with lots of Constellation experience, provided technical advice on settings and handling; he was also the photographer for the day.

The Connie used about 150 feet to get off the ground at about 70-percent power. After takeoff, the gear was retracted and then the flaps, and a couple of flybys were made for the photos and to check out the trim and stability. The flight performance was excellent, with very little trim change with power changes and no roll or yaw problems. After about 5 minutes, the Connie was slowed down a bit, the gear was lowered and then the flaps, a few degrees at a time, to set up the approach. The landing was with the mains first, and during the rollout, the two inboard engines quit. This looked just like when Connies used to taxi up to the gate with just the two outboards running! Frank and his crew will be out in the spring to let the Connie fly again, and he plans to put up a lot more flights this flying season. ✈